The US Army's Center for Strategy and Force Evaluation

STUDY REPORT
CAA-SR-93-15

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MASTER DATA CALIBRATION PROJECT - PHASE ONE (MADCAP-1)

DECEMBER 1993
(Revised July 1994)

PREPARED BY
FORCE EVALUATION DIRECTORATE

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13. ABSTRACT (Maximum 200 words)

The Tactical Warfare Model (TACWAR) Model is used by US Army Central Command (CENTCOM). TACWAR takes the operational input data derived from Combat Sample Generator (COSAGE) and uses those inputs to assist in driving the TACWAR scenarios. There are two objectives for this study. The first is to develop combat samples that provide, as a minimum, the operational probability of kill (PK), operational rate of fire, and allocation of fires for theater weapon systems, in each desired tactical posture, for use in TACWAR. The second objective is to ensure that the required data audit trail is developed to support the use of this data in TACWAR.

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DEPARTMENT OF THE ARMY
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REPLY TO
ATTENTION OF:

CSCA-TCT (5-5d)

27 JUN 1994

MEMORANDUM FOR US CENTRAL COMMAND, COMBAT ANALYSIS GROUP, ATTN: JOEL BANKS, MACDILL AFB, FL 33621-5101

SUBJECT: Master Data Calibration Project - Phase One Study

1. Reference memorandum, CCCA, US Central Command, 6 Nov 92, subject: Development of Combat Samples for TACWAR.

2. Referenced memorandum requested that the US Army Concepts Analysis Agency (CAA) provide combat samples to the US Central Command for use in updating their Tactical Warfare (TACWAR) attrition database for their OPLAN 1002-95.

3. The final report documents the results of our analyses and incorporates your comments on the draft report. Included is an executive summary which provides an overview of the entire study and principal findings for essential elements of analysis. Questions and/or inquiries should be directed to the Chief, Tactical Warfare Branch, US Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethedsa, MD 20814-2797, DSN 295-5251.

4. You are given authorization to reproduce this document and provide copies to outside organizations.

5. I would like to express my appreciation to all the staff elements and agencies which have contributed to the study.

E.B. VANDIVER III
Director

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CAA	**MASTER DATA CALIBRATION PROJECT-PHASE ONE (MADCAP-1)**	**STUDY SUMMARY CAA-SR-93-15**

THE REASON FOR PERFORMING THE STUDY was to develop combat sample attrition data that provided some of the required inputs to the Tactical Warfare (TACWAR) Model. Development of these inputs provides an audit trail on which the sponsor can rely.

THE STUDY SPONSOR is Combat Analysis Group, US Central Command, through the Deputy Under Secretary of the Army - Operations Research (DUSA-OR). Sponsor's point of contact is Mr. Joel Banks, DSN 468-9266.

THE STUDY OBJECTIVE is to develop combat samples that provide as a minimum, the operational probability of kill (PK), operational rate of fire and allocation of fires for theater weapon systems, on each desired tactical scenario, for use in TACWAR; to ensure that the required data audit trail is developed to support the use of this data in TACWAR.

THE SCOPE OF THE STUDY was the development of the operational probability of kill, operational rate of fire, and allocation of fires for each potential weapon system interaction in the Southwest Asia theater of operations. This study examines US forces deployed against a threat force. Timeframe for this study is 1995.

THE MAIN ASSUMPTION of this work is that attackers are fully mounted in their vehicle, and every time a unit defends, it is fully dismounted. The effect of this assumption is that there are different levels of combat strength displayed for the same forces, depending on the unit posture (attacking or defending).

THE BASIC APPROACH used in this study was to use stylized (Blue and Red) forces in the Combat Sample Generator (COSAGE) to determine the attrition data. This data from these simulations is analyzed and postprocessed into an acceptable TACWAR format.

THE PRINCIPAL FINDING of this study is that combat samples can be constructed to support TACWAR in the Southwest Asia theater of operations. The data provided to US Central Command (CENTCOM) includes the operational probability of kill, operational rate of fire, and allocation of fires for all weapon systems found in the theater of operations.

THE STUDY EFFORT was directed by CPT Robert A. Powell and CPT Robert S. Elias, Tactical Branch, Force Evaluation Directorate.

COMMENTS AND QUESTIONS may be sent to the Director, US Army Concepts Analysis Agency, ATTN: CSCA-FEF/T, 8120 Woodmont Avenue, Bethesda, Maryland 20814-2797.

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MASTER DATA CALIBRATION PROJECT - PHASE ONE (MADCAP-1)

CHAPTER 1

EXECUTIVE SUMMARY

1-1. PROBLEM. The theater model, Tactical Warfare (TACWAR), requires many specific inputs to accurately portray the desired scenario. Many of these inputs are available, easily understood, and properly documented. A few of the necessary inputs are not readily available for TACWAR, nor are they provided in a comprehensive package, complete with documentation. The United States Army Central Command (CENTCOM) requested that the United States Army Concepts Analysis Agency (CAA) conduct a study to determine the necessary attrition inputs for TACWAR.

1-2. BACKGROUND. Data reliability is as important in simulations as is the analyzed output. In 1990, CENTCOM initiated an effort to determine accurate values for TACWAR input data that did not have an approved audit trail. CENTCOM contacted CAA during Operation DESERT SHIELD and requested CAA assistance in determining these values. CENTCOM does not have ready access to the raw data that must be determined in operational form for input values in TACWAR. There are three input values that need to be determined: operational PK, operational rate of fire, and allocation of fires. This data must cover all of the various weapon types and mixes. CAA's high-resolution simulation, the Combat Sample Generator (COSAGE), can provide these operational values for CENTCOM and other TACWAR users. The MADCAP-1 Study is a follow-on to the initial CENTCOM study conducted during Operation DESERT SHIELD. In MADCAP-1, CENTCOM is requesting Southwest Asia data for the 1995 timeframe.

1-3. SCOPE

a. CAA will provide analytical data for the Southwest Asia theater of operations.

b. Timeframe: 1995.

c. Forces: US versus threat.

d. The model will consider all weapons and systems versions currently in the Total Army inventory.

e. CAA will develop eight specific scenarios that represent the style of operational forces and joint operations that typify the CENTCOM theater.

1-4. OBJECTIVE. There are two objectives for this study. The first is to develop combat samples that provide, as a minimum, the operational PK, operational rate of fire, and allocation of fires for theater weapon systems, in each desired tactical scenario, for use in TACWAR. The second objective is to ensure that the required data audit trail is developed to support the use of this data in TACWAR.

1-5. LIMITATIONS. The combat sample process contains two tactical limitations that must be discussed to ensure full understanding of the capabilities and limitations of COSAGE. These limitations are:

a. Combat samples employ weapons without degradation due to fatigue, low morale, poor training, or low experience levels. The lack of use of these factors provides a highly efficient weapon/soldier throughout the simulated combat.

b. No electronic countermeasures are used by Blue or Red forces. There is no attempt to reduce or impede the use of the electronic surveillance devices, radios, or radar. The area of greatest impact is in counterbattery fires and radio transmissions. Red forces have no means of jamming Blue counterbattery radar or radio transmissions.

1-6. TIMEFRAME. This study is a near-term study. The data represents United States (Blue) and threat (Red) forces in 1995.

1-7. KEY ASSUMPTIONS

a. Equipment substitutions for Blue and Red force inventories accurately depict the capabilities of the sponsor-requested equipment.

b. Attackers are fully mounted in their vehicles, and every time a unit defends, it is fully dismounted. The effect of this assumption is that there are different levels of combat strength displayed for the same forces depending on the unit posture (attacking or defending).

c. Forty-eight hours of simulated combat is sufficient to develop calibration statistics for TACWAR.

d. Fratricide causes only insignificant losses.

1-8. APPROACH/METHODOLOGY. Ensuring the accuracy of the initial input data is the cornerstone of all studies. To guarantee meeting this requirement, the study sponsor provided all initial weapon system types, quantities, and force structures, and provided continuous guidance throughout the study to ensure that the postures accurately represented the joint operations of CENTCOM. CAA developed these into representative forces and fought them in simulated combat for 48 hours in eight postures.

a. These eight postures, simulated using COSAGE, are shown below and explained in Chapter 4.

Red attack - Blue prepared defense
Red attack - Blue hasty defense
Red attack - Blue delay
Blue attack - Red prepared defense
Blue attack - Red hasty defense
Blue attack - Red delay
Static (Blue vs Red)
Tactical air (TACAIR) (Blue vs Red)

b. The results of these postures are analyzed against the established TACWAR measures of effectiveness (MOE) and essential element(s) of analysis (EEA) for accuracy and then processed through the COSAGE-TACWAR Interface (CTI) to be put in a format compatible for use in TACWAR. The TACWAR EEA are listed and explained in paragraph 1-9.

1-9. ESSENTIAL ELEMENTS OF ANALYSIS. Several EEAs were selected and approved for use in this study. These EEAs are listed below with corresponding answers.

a. EEA 1. Do the Forces Follow Sound Doctrinal Principles? Each phase of the study is doctrinally sound for:

(1) Joint operations

(2) Unit mission

(3) Unit organization

(4) Unit employment (combined arms operations)

(5) Weapon employment

(6) Attacking and defending force ratios

b. EEA 2. Do the Samples Make Sense from Joint and Tactical Points of View? Input from CENTCOM and comparisons of previous studies have indicated the joint operations aspect of the study is accurate. Analysis of tactical deployments and movements is based on a historical search and comparison of previously completed and approved studies. Tactical units in this study show similar initial deployment and movement to historical samples. There is a slight variation in the initial inventories for all forces. This is due to the differing study timeframes. The combat results of these scenarios are checked against the historical data also compiled from previous studies. The output data are used to calculate the system exchange ratio (SER), the force exchange ratio (FER), and the loss exchange ratio (LER). Comparing these values to historical data provides an excellent check for study consistency. In each case, the determined SERs, FERs, and LERs are consistent with historical trends set by previous studies with emphasis on joint operations.

c. EEA 3. Are There Appropriate and Significant System Interactions within the Combat Samples?

(1) Several steps are taken to ensure appropriate and significant system interactions within the scenario replications. Inspection of the killer/victim matrix provides an indication of how well the weapon systems are interacting. If there is system interaction between expected systems, then the posture is acceptable on this basis. If there are sparse interactions, say between two opposing tanks, then further investigation is conducted to discover the cause of the lack of interactions. Once the cause of the sparse interactions is identified and corrected, the scenario is rerun and the killer/victim matrix regenerated for inspection. This procedure is repeated until all expected interactions occur. In the final simulations, all interactions occurred as planned.

(2) Following a check for sparse interactions, a series of common sense "benchmarks" are applied to the calibrated output. These benchmarks are based on historical precedent and common sense. For example, it is expected that the M1A1 tank will have a better operational capability than the older M48A5. Each posture is reviewed for compliance with the benchmarks, and all passed the common sense portion of the test.

1-10. OTHER KEY FINDINGS. Both CENTCOM and CAA need to pursue the concept of attrition calibration in TACWAR and to mutually work toward this end.

1-11. THREAT GUIDANCE. All threat guidance is provided and checked by members of the CENTCOM Operations Analysis Center.

1-12. CONSTRAINTS

a. This study includes constraints on the timeframe of the study and on the types of equipment and munitions used. All constraints are dictated by the sponsor in either the initial study directive or follow-on conversations. These constraints include such requirements as types of weapon systems used, ammunitions employed, and density of units and equipment. COSAGE allows for significant numbers of specific weapons to be played. TACWAR is limited to 10 or 12 categories per side, and many of the individual pieces of equipment played uniquely in COSAGE are rolled up into these categories (Table 4-3, Chapter 4). This type of aggregation is expected, given the scope of each simulation.

b. COSAGE can play unlimited quantities of each weapon system; however, COSAGE can play only a limited number of weapon systems. COSAGE cannot model every weapon in the force.

1-13. QUALITY CONTROL. There were several concerns regarding combat samples. Reshaping of the battlefield on a number of issues was required.

a. After some surprising results in which HMVT2 had a larger PK against T72 vice T62, extensive research was conducted to ascertain a reason. In consulting with United States Army Materiel Systems Analysis Activity (AMSAA), it was discovered that HMVT2 PK values against the T62 and T72 were equal. Therefore, it is reasonable for COSAGE to report a higher PK against either. Additionally, the number of HMVT2s was statistically increased for the Red attack/Blue prepared defense and Red attack/Blue hasty defense postures to present a more rigorous interaction of HMVT2 against enemy targets.

b. Other PK changes involve refined PK data received from AMSAA for the M1A1 versus T72, T72 versus M1A1, and the HELLFIRE II versus all targets. This PK data was necessary because the old PK values may have produced erroneous results.

c. A significant effort resulted in committing T62 units earlier in the battle and increasing T62 movement speeds and battle speeds to improve overall battle intensity. Additionally, the resolve of T62 unit commanders was changed to a more aggressive profile (i.e., changed from willing to absorb 30 percent unit loss of critical equipment to 60 percent loss).

d. The DESERT SHIELD crisis resulted in an average engagement range of 3,000 kilometers (km) from Apache to target. This was a criteria for purposes of identification. Fratricide occurs when the Apache's range is greater than 3,000 km.

e. COSAGE results show a high allocation of Blue and Red shooters (i.e., M1A1, M2IFV, ITV, HMVT2, BMP3M, and BRDM3) against helicopters. This resulted from helicopters being located at their minimum engagement range. To overcome this, the ranges of all helicopters was lengthened to decrease the number of helicopters fired at

in COSAGE. This represents a realistic problem for the Apache; longer ranges increase helicopter survivability but also increase the probability of fratricide.

f. It was discovered that ROPAT3 was designated as an air defense system which precluded firing at primary targets. Because the ROPAT3 is not an air defense system, it was designated as an antiair defense system. This change resulted in ground systems then being targeted by the ROPAT3.

1-14. CONCLUSION. The principal finding of this study is that combat samples can be constructed to support TACWAR in the Southwest Asia theater of operation. The data provided to US CENTCOM included the operational probability of kill, operational rate of fire, and allocation of fires for all weapon systems found in the theater of operations. As each posture was developed, combat samples were tested and analyzed. This analysis determined input validity, checked performance data to ensure doctrinal correctness and tactical feasibility, and determined if results were compatible with postprocessors. This process constitutes a COSAGE audit trail.

CHAPTER 2

INTRODUCTION

2-1. BACKGROUND

a. The MADCAP-1 Study is a follow-on to the initial CENTCOM study conducted during Operation DESERT SHIELD. Much of the ground work for this study was laid during Operation DESERT SHIELD. While providing analytical support during this conflict, CENTCOM recognized the need to produce accurate and auditable operational PK, operational rates of fire, and allocation of fires for weapon systems in campaign analysis. During this initial effort, CENTCOM provided several personnel to do research in data requirements and to measure the feasibility of using the combat sample process as the source for that data. CENTCOM representatives teamed up with CAA personnel, under the CENTCOM flag, to produce data and interface support for use in Operation DESERT SHIELD analysis.

b. Various studies, conducted after Operation DESERT SHIELD, concluded that a feeder model is needed to produce the three inputs listed above. A feeder model is a model that provides data for another model. Recognizing the need for a reliable and auditable source for these inputs, CENTCOM requested that CAA conduct a study to produce the operational probability of kill, operational rate of fire, and allocation of fires factors for a conflict in the Southwest Asia (SWA) theater. In MADCAP-1, CENTCOM is requesting Southwest Asia data for the 1995 timeframe.

2-2. PURPOSE. The purpose of the study is to determine a reliable and editable source for operational PK, operational rates of fire, and allocation of fires for weapon systems in campaign analysis.

2-3. OBJECTIVE. There are two objectives for this study. The first is to develop combat samples that provide, as a minimum, the operational PK, operational rate of fire, and allocation of fires for theater weapon systems, in each desired tactical posture, for use in TACWAR. This is to be achieved for various combat postures. The second objective is to ensure that the required data audit trail is developed to support the use of this data in TACWAR.

2-4. STUDY LIMITATIONS. The combat sample process contains two limitations that must be discussed prior to acceptance of the final results. In each case, the limitation directly affects the outcome of the simulation and the manner in which the combat is fought.

a. Combat samples employ weapons and soldiers without degradation due to breakdown, fatigue, low morale, poor training, or low experience levels. This implies that a highly efficient weapon/soldier is employed throughout the simulated combat.

b. The second limitation found within this study is the lack of any type of electronic countermeasures used by Blue or Red forces. This means that there is no attempt to reduce or impede the use of the electronic surveillance devices, radios, or radar. The area of greatest impact is in counterbattery fires and radio transmissions. Red forces have no means of jamming Blue counterbattery radar or radio transmissions.

2-5. STUDY ASSUMPTIONS

a. Attackers are fully mounted in their vehicle, and every time a unit defends, it is fully dismounted. The effect of this assumption is that there are different levels of combat strength displayed for the same forces, depending on the unit posture (attacking or defending).

b. Forty-eight hours of simulated combat is sufficient to develop calibration statistics for TACWAR.

c. Fratricide causes only insignificant losses.

2-6. FORCE DEVELOPMENT

a. Unit organizations and force strengths are derived from template organizations developed for this theater of operations and participants involved. These templates are derived from a study (to be published) entitled Wartime Requirements Analysis SWA, FY 1995 (WARREQ-95M) force structure. Special emphasis was placed on the accurate depiction of the joint operations capability of CENTCOM's force structure. United States Air Force, Marine, and Army units, weapons, and munitions are represented in numbers that represent the actual proportion of those units in theater. Examples of the service, weapon systems, and munitions that are represented within the simulation include the US Air Force F-16, F-15, and A-10 firing/dropping/launching the following munitions: MK-20 or AGM-65. These aircraft flew at a sortie rate that reflects the rate they will maintain during conflict.

b. The final base case inventories and force layouts (templates) in Figure 2-1 are described in paragraph 4-2, Chapter 4. WARREQ-95M templates provided the basic division size and structure for each force within the simulation. The initial template is corrected to reflect the specific forces and timeframe requested. The study sponsor approved all force structures used in MADCAP.

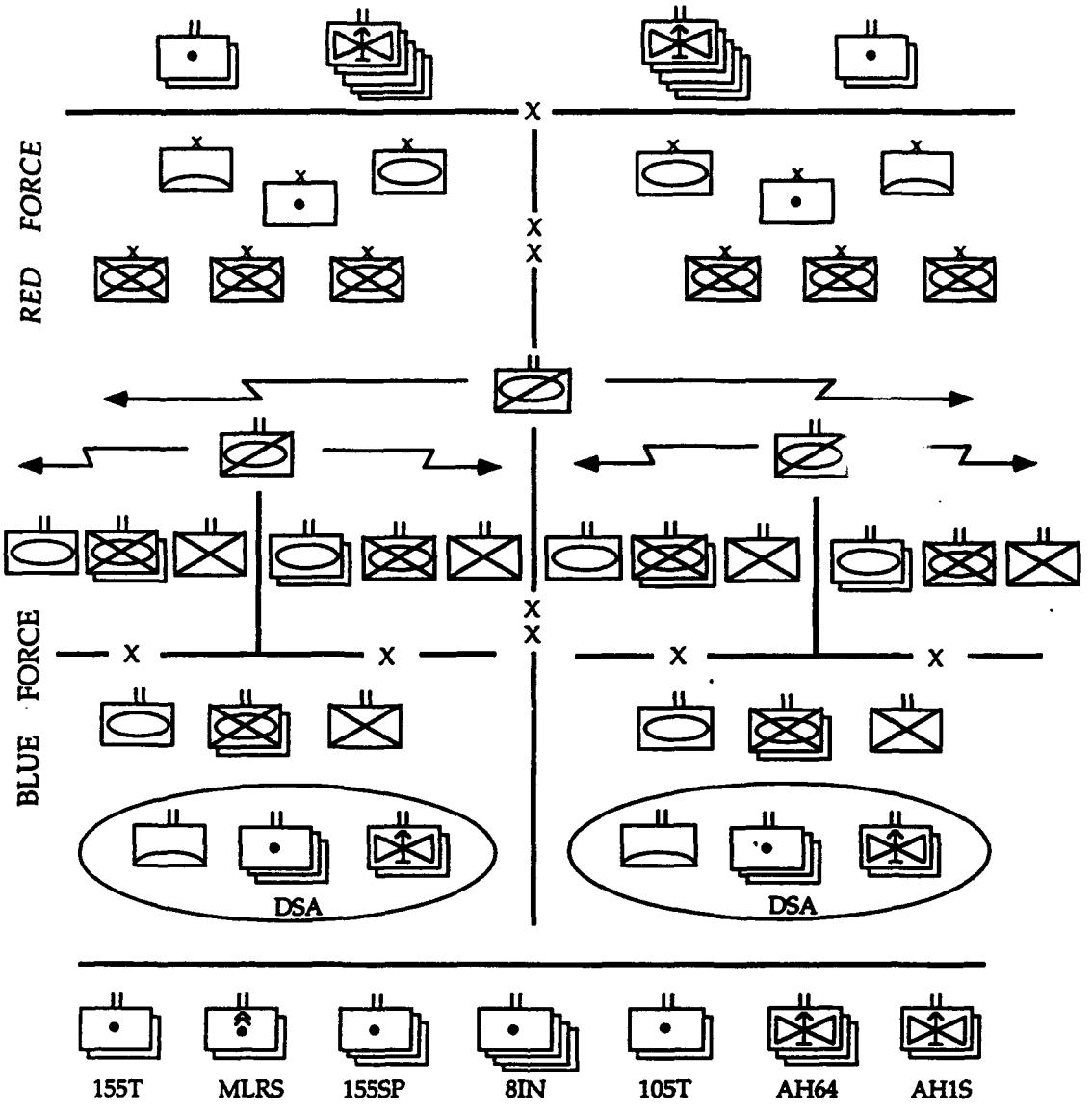

Figure 2-1. Force Structure

CHAPTER 3

ARMOR AND INFANTRY WEAPON APPLICATIONS TO GROUND TARGETS

3-1. INTRODUCTION. A basic part of any combat simulation is the process by which battlefield targets are damaged, destroyed, or incapacitated. COSAGE uses a measure called PK to determine the likelihood of a shot from a weapon achieving mission-ending damage to a vehicle or incapacitating a personnel target. The method by which these probabilities of kill, required for hundreds of combinations of shooters and targets, are put into the COSAGE process is by a time-consuming, labor-intensive transfer of data from hard copy tables to COSAGE-readable computer files.

3-2. HIT AND KILL PROBABILITY PARAMETERS

a. PK data from the Armor and Infantry Branches of the AMSAA Ground Warfare Division typically is received in the form of letter-size tabular sheets. Nearly all of the armor weapon PK data and much of the infantry weapon PK data contains the following data varying by range and target exposure:

(1) Probability of hit, P(H)

(2) Probability of kill given a hit, P(K|H)

(a) Probability of a mobility kill, M-kill, given a hit, $P(K_M|H)$

(b) Probability of a firepower kill, F-kill, given a hit, $P(K_F|H)$

(c) Probability of a mobility or a firepower kill, M/F-kill, given a hit, $P(K_{M/F}|H)$

(d) Probability of a catastrophic kill, K-kill, given a hit, $P(K_K|H)$.

(3) Probability of kill given a shot, P(K|S)

(a) Probability of a mobility kill, M-kill, given a shot, $P(K_M|S)$

(b) Probability of a firepower kill, F-kill, given a shot, $P(K_F|S)$

(c) Probability of a mobility or a firepower kill, M/F-kill, given a shot, $P(K_{M/F}|S)$.

(d) Probability of a catastrophic kill, K-kill, given a shot, $P(K_K|S)$.

b. Tank and antitank missile source data is illustrated in unclassified form in Figure 3-1. Even though the data is shown as tank-on-tank effectiveness data, the same type data applies for antitank (AT) missiles fired at ground vehicles.

Stationary tank ALFA
vs
Stationary tank ZEBRA

Attack angles assumed to be cardioid distribution

Range (M)	Hit prob	Probability of kill							
		Given a hit				Given a shot			
		M	F	MF	K	M	F	MF	K
	(Target in defilade exposure)								
500	.492	.649	.714	.714	.344	.319	.352	.352	.169
1,000	.238	.560	.625	.625	.298	.133	.148	.148	.071
1,500	.085	.505	.569	.569	.267	.043	.048	.048	.023
2,000	.023	.484	.549	.549	.256	.011	.012	.012	.006
2,500	.006	.477	.542	.542	.252	.003	.003	.003	.001
3,000	.002	.475	.540	.540	.251	.001	.001	.001	.000
	(Target in full exposure)								
500	.950	.624	.603	.674	.343	.596	.576	.644	.328
1,000	.702	.559	.457	.598	.258	.396	.324	.424	.184
1,500	.315	.522	.395	.559	.215	.166	.124	.177	.068
2,000	.094	.507	.374	.543	.201	.048	.035	.051	.019
2,500	.025	.502	.361	.537	.194	.013	.009	.013	.005
3,000	.008	.500	.354	.534	.190	.004	.003	.004	.002

Note: unclassified - values are for illustrative purposes only

Figure 3-1. Armor PK Data

c. COSAGE allows fire upon a detected target within range of an available weapon system and does not consider the probability of hit as a separate condition. Therefore, the type of PK selected to be the criterion for a target kill in the COSAGE direct fire simulation is the probability of a mobility or firepower kill given a shot, $P(K_{M/F}|S)$.

3-3. TANK GUN AND ANTITANK MISSILES. In the engagement of a target by a single shot weapon, such as a tank main gun, more than one round may be fired at the target before the engagement is terminated. For this reason, AMSAA sometimes annotates its PK data as "first round" data or as various types of "subsequent round" data. Depending on the sensing of the previous round, the data for the subsequent round is annotated "hit given a hit," "hit given a sensed miss," or "hit given a lost miss." If the number of rounds fired in a given engagement is known, and the sensing of all rounds that precede other rounds as well as the probabilities of the sensed conditions of these previous rounds are known, then an average PK of all the rounds fired during the engagement can be calculated. This average PK is called a single shot probability of kill, or SSPK. This SSPK value is useful, since many combat simulations, including COSAGE, use only one value of PK for any event of a particular weapon and round engaging a specific target, regardless of the sequence of the round during the engagement. COSAGE does not use target parameter inputs, e.g., rounds per target engagement, probability of hit, or probability of sensing a miss. Therefore, whenever the round sequence is identified, the SSPK values for COSAGE are taken from data annotated as "first round" data. This is equivalent to treating the data as representing rounds that are independent of previous rounds fired.

3-4. INFANTRY AUTOMATIC WEAPONS. Included in infantry automatic weapons are machineguns and automatic cannon. The AMSAA Infantry Branch gives probabilities of kill for these in terms of M-kills, F-kills, M/F-kills, and K-kills. An additional category of kills is given when these automatic weapons are fired at personnel carrier vehicles. This category is the expected fraction of casualties, Ec, of the noncrew personnel carried in the troop carrier. Casualty effects by these automatic weapons are given as a probability fraction or expected fraction of kill per burst of multiple rounds. The burst size or rounds per burst is a part of the block of data given for the weapon. The probability of kill of automatic weapons against dismounted personnel is given in terms of a probability of incapacitation, P(I), of a one-man target by at least one round of a burst or in terms of an expected fraction of casualties, fc, of a multiple-person target. Automatic weapon PK data is illustrated in Figure 3-2.

a. The casualty criteria for personnel incapacitation are 30-second assault, 5-minute assault, and 30-second defense. The times are the periods between injury and incapacitation while either attacking or defending. If the soldier is wounded by one or more rounds of ball ammunition or fragments of high-explosive ammunition, so that he is unable to perform a useful military function within his tactical role and he becomes incapacitated within the time specified, he is considered a casualty. The probability of incapacitation is given as a function of target exposure or posture. This posture is relative to humans versus tactical posture. For defending personnel, the target postures are crouching, prone, and standing in foxhole. For attacking personnel, the target postures are standing, crouching, and prone. For two-man weapon emplacements in the attack, the postures are crouching and prone.

WEAPON: MG 1 MACHINEGUN	**TARGET (W X D): 3.0 X 3.0**
MOUNT: BIPOD	**NUMBER OF MEN: 3**
CASUALTY CRITERION: 30-SECOND ASSAULT	**HUMAN POSTURE: CROUCHING**
ROUNDS PER BURST: 10	

FRACTION CASUALTIES (F-BAR)

RANGE (M)	F-BAR
100.	0.28
200.	0.11
300.	0.05
400.	0.03
500.	0.01

Note: Unclassified - values are for illustrative purposes only.

Figure 3-2. Automatic Weapon PK Data

b. All personnel in a target are assumed to be in a common posture and wearing a winter uniform with helmet. The overall personnel targets and individual personnel within the targets are considered stationary during the engagement. The data does not reflect target protective countermeasures that might be taken, such as fleeing or changing postures. Also, the effectiveness results are assumed to reflect weapon performances under daytime conditions unhampered by battlefield obscurants; nevertheless, they do not typify the performance of weapons in proving ground tests, demonstrations, or tests where artificial conditions exist.

c. Sometimes adjustments have to be made for some sets of weapon data that are not sufficiently consistent with other data for the same weapon system. For example, COSAGE can accommodate only two different rates of fire from the same weapon system, one for fire against ground targets, and the other for fire against aerial targets. Therefore, when PK data for a particular weapon, based on one number of rounds per burst, has been entered into a COSAGE file, it may become desirable to incorporate data for the same weapon with a different burst size against the same category of target, either ground or air. In this case, those sets of PK data involved have to be adjusted, where necessary, to conform to the same number of rounds per burst.

d. PK adjustment for burst size change is accomplished in the following manner.

(1) Suppose a certain automatic weapon is currently being played in COSAGE with PK values based on a burst size of 15 rounds.

(2) Next, suppose new PK data becomes available for this weapon against a particular target based on a burst size of 10 rounds. Let this 10-round PK value at 500 meters be 0.375 against a fully exposed target vehicle.

(3) The PK value of the 10-round burst is transformed to values corresponding to a 15-round burst by assuming the sufficiency of the binomial relationship,

$$PK_{N2} = 1 - (1-PK_{N1})^{N2/N1}, \text{ where}$$

N1 = First burst size = 10
N2 = Second burst size = 15

PK_{N1} = Probability of kill for N1 rounds = 0.375
PK_{N2} = Probability of kill for N2 rounds

$$\text{Thus, } PK_{15} = 1-(1-0.375)^{15/10}$$
$$= 1-(0.625)^{1.5}$$
$$= 1-0.494$$
$$= 0.506$$

(4) This transformation of PKs from the first burst size to the second will then be done for PK values at all ranges and for both exposure postures, hull defilade as well as fully exposed.

e. Rounds per burst for various systems used in COSAGE are shown in Table 3-1.

Table 3-1. Burst Sizes of COSAGE Weapons
(page 1 of 2 pages)

Blue weapon system	Target	Rounds per burst
5.56mm M16A1/A2 Rifle	Gnd	3
5.56mm SAW	Gnd	6
7.62mm M14 rifle	Gnd	3
7.62mm MG (pintle)	Gnd Hel	10 9
.50 Cal. MG (pintle)	Gnd Hel	10 9
20mm Hel cannon	Gnd Hel	38 12
30mm Hel cannon	Gnd Hel	25 12
25mm BUSHMASTER gun (M2/M3/LAV-25)	Gnd Hel	5 3
40mm M203 GL	Gnd	1
40mm MK 19-3 AGL	Gnd	3
20mm VULCAN AD gun	Gnd Hel	10 50
HYDRA 70 Rkt 2.75	Gnd Hel	6 6
Non-US NATO weapon system	**Target**	**Rounds per burst**
20mm MARDER-mtd gun	Gnd Hel	5 3
35mm GEPARD AD gun	Gnd Hel	20 18
40mm BOFFIN AD gun	Hel	5

Table 3-1. Burst Sizes of COSAGE Weapons
(page 2 of 2 pages)

Red weapon system	Target	Rounds per burst
5.45mm AK47 rifle	Gnd	3
7.62mm AKM rifle	Gnd	10
7.62mm SVD rifle	Gnd	1
12.7mm MG (pintle)	Gnd	10
14.5mm MG (pintle)	Gnd Hel	10 6
12.7mm Hel MG	Gnd	10
23mm Hel cannon	Gnd Hel	20 10
30mm Hel cannon	Gnd Hel	25 20
14.5mm ZPU-4 AD MG	Gnd Hel	10 8
23mm ZSU 23/4 SP AA gun	Gnd Hel	20 20
30mm 2S6 (ZSU-X) SP AA gun	Gnd Hel	20 20
30mm BMP- mtd gun	Gnd Hel	5 10
37mm AA gun	Hel	4
57mm AA gun	Hel	4
30mm AGS-17 AGL	Gnd	5
57mm Hel rkt	Gnd	32

f. When seeking PK values for infantry weapons, caution needs to be taken in selecting the data set which is appropriate for the weapon mounting method. The method of mount for the weapon, whether ground-, pintle-, or cupola-mounted, results in varying degrees of weapon stability, and thus varying degrees of accuracy and probability of hit. For example, a certain machinegun shooting at a particular vehicle at a particular range and in a particular exposure has a PK of 0.23 when mounted in a turret or cupola, 0.15 when pintle-mounted, and 0.06 when fired from a ground mount.

CHAPTER 4

EXECUTION

4-1. STUDY APPROACH/METHODOLOGY

a. What is COSAGE? COSAGE is a two-sided, symmetrical, high-resolution, stochastic combat simulation. It models ground-to-ground, ground-to-air, and air-to-ground combat. This tool develops shooter/target interactions and final killer/victim matrices on which the Attrition Calibration (ATCAL) parameters are based. COSAGE is used at CAA as the feeder model for all theater analysis. In this study, COSAGE is used similarly to feed the theater simulation, TACWAR, by developing the three factors necessary as operational inputs. By using COSAGE and the associated audit trail, TACWAR is able to receive editable input factors for the operational PK, operational rates of fire, and allocation of fires. ATCAL is an iterative mathematical algorithm which develops steady state attrition statistics and ammunition expenditures for forces differing in number and composition from a calibrated base combat sample. Used properly, ATCAL can automatically adjust rates of fire as a function of changing firer/target densities.

b. What is TACWAR? TACWAR is a deterministic, theater-level combat simulation that examines the interaction of strategic and tactical forces in a conventional, nuclear, and/or chemical environment. TACWAR is a noninteractive, two-sided model, simulating corps operations, although smaller units can be modeled. TACWAR is used as the final modeling tool by CENTCOM. TACWAR uses the operational input data derived from COSAGE and ATCAL, among other sources. The methodology used in TACWAR to determine the weapon system value is the antipotential potential (APP). A friendly weapon system's value is dependent on the rate at which that system kills enemy systems on the battlefield and on the value of those systems. To determine an opposing enemy weapon system's value, the same method must be employed. This system is circular in its determination of these values, since each value is determined from the value of the systems it kills.

c. COSAGE-TACWAR Interface (CTI). Raw combat sample data requires some transformation for successful implementation within TACWAR. To solve this problem, Conventional Forces Assessment Division (CFAD), J-8, and CAA developed the CTI. The CTI acts as an initial preprocessor of raw COSAGE output. CTI employs COSAGE output data and collects the operational PK, rate of fire, and allocation of fires and places it into a file readable by TACWAR. These new files are then used as TACWAR input files, generating starting data for each scenario.

d. Posture Formulation

(1) This study requires the use of eight specific postures to properly and accurately simulate all of the postures requested by the study sponsor (Table 4-1). Force ratios are operationally driven. There is no standard doctrine for designed ratios. Favorable force ratios are based on mission, enemy, terrain, troops, and time available (METT-T) analysis, capabilities of both friendly and enemy troops and intangibles such as general state of training, morale, health, and welfare of both friendly and enemy forces. Force ratios are increased or decreased on the basis of a synchronized control of the complete battlefield architecture. Field Manual (FM) 100-5, Operations, June 1993, states, "Commanders use every resource available to offset the attacker's numerical advantage;" hence, the concept of massing effects

rather than forces. The template force structures are updated to represent the current CENTCOM force structure (scheduled for deployment to SWA) and current threat force structure. The force structures are then combined into specific postures. The study sponsor requested specific organizations and unit representations within each posture. The following postures are the result of the development process (Blue represents US forces/Red represents threat forces).

Table 4-1. Posture Profile

Posture description	Force ratio (attacker/ defender)
Red attack - Blue prepared defense	3:1
Red attack - Blue hasty defense	3:1
Red attack - Blue delay	4:1
Blue attack - Red prepared defense	2:1
Blue attack - Red hasty defense	2:1
Blue attack - Red delay	2:1
Defense light (Blue vs Red)	1:1
TACAIR (Blue vs Red)	N/A

(2) The postures are defined as:

(a) Red Attack - Blue Prepared Defense. Red forces attacking a Blue force in a prepared defensive position with prepared alternate and secondary positions. Blue force employs emplaced minefields. Red forces attack with a doctrinal force ratio advantage of 3:1.

(b) Red Attack - Blue Hasty Defense. Red forces attacking Blue forces in hastily prepared defensive positions. Red forces attack with a doctrinal force ratio of about 3:1.

(c) Red Attack - Blue Delay. Red forces attacking Blue forces conducting a delaying action. Red forces attack with a doctrinal force ratio of about 4:1.

(d) Blue Attack - Red Prepared Defense. Blue forces attacking Red forces in a prepared defensive position with prepared alternate and secondary positions. Red force utilizes emplaced minefields. Blue forces attack with a doctrinal force ratio advantage of 2:1.

(e) Blue Attack - Red Hasty Defense. Blue forces attacking Red forces in hastily prepared defensive positions. Hasty attack does not allow time for the emplacement of mines. Blue forces attack with a doctrinal force ratio of about 2:1.

(f) Blue Attack - Red Delay. Blue forces attacking Red forces conducting a delaying action. Blue forces attack with a doctrinal ratio advantage of 2:1.

(g) Defense Light (Blue vs Red). This posture is fought to determine the results of conflict that is started when the opposing forces approximately equal each other in size. The battle is initiated with preplanned artillery fires and rear area helicopter missions. Forces in this posture are about 1:1.

(h) TACAIR (Blue vs Red). The defense light posture is used but with a large number of preplanned TACAIR support missions. The result of this posture is that there is no ground-on-ground combat, rather all air-to-ground combat and some artillery fires. The data from this posture is used in the TACWAR air module. Air forces of both sides accurately reflect the anticipated type and numbers of combat aircraft operating in a close air support role, as well as their sortie rate. Munition effects agree with United States Air Force (USAF) Joint Munitions Effectiveness Manual standards. Except for the TACAIR posture, the sortie generator rate for each aircraft averaged about 1.0 sortie per day. The TACAIR posture modeled surge rates with a resulting higher rate of about 1.5 sorties per day.

(3) Executing COSAGE. Each of the above listed postures is replicated 16 times to ensure statistical validity. The resulting data from these replications is then postprocessed into a manageable form from which the analysis takes place. Details of the postprocessing and analysis are contained in Chapter 5 of this report.

(4) Data Audit Trail. One of the main objectives is to provide a data package to CENTCOM that is completely auditable. The data provided by the combat sample process fulfills this requirement; it is completely auditable to its originating source. For example, any of the PK data provided as input data for TACWAR can be traced back to its original hardstand SSPK provided to CAA by AMSAA. Figure 4-1 demonstrates how the audit trail works. COSAGE output feeds into the APP CTI and ATCAL Reduction Program. The starting point is the TACWAR input which is traced to the CTI. The input to the CTI is the output from the Combat Sample Generator. **COSAGE output is used to compute operational PK, firing allocation, and rates of fire.** Continuing the audit trail leads to a variety of schools and laboratories which provide tactics and doctrine. All equipment data is traceable to the program managers or to the United States Army Training and Doctrine Command (TRADOC) responsible school. Doctrinal issues are traceable to specific field manuals or to doctrinal theory evolving from TRADOC (i.e., JCS Publication (Pub) 3-0 and FM 100-5).

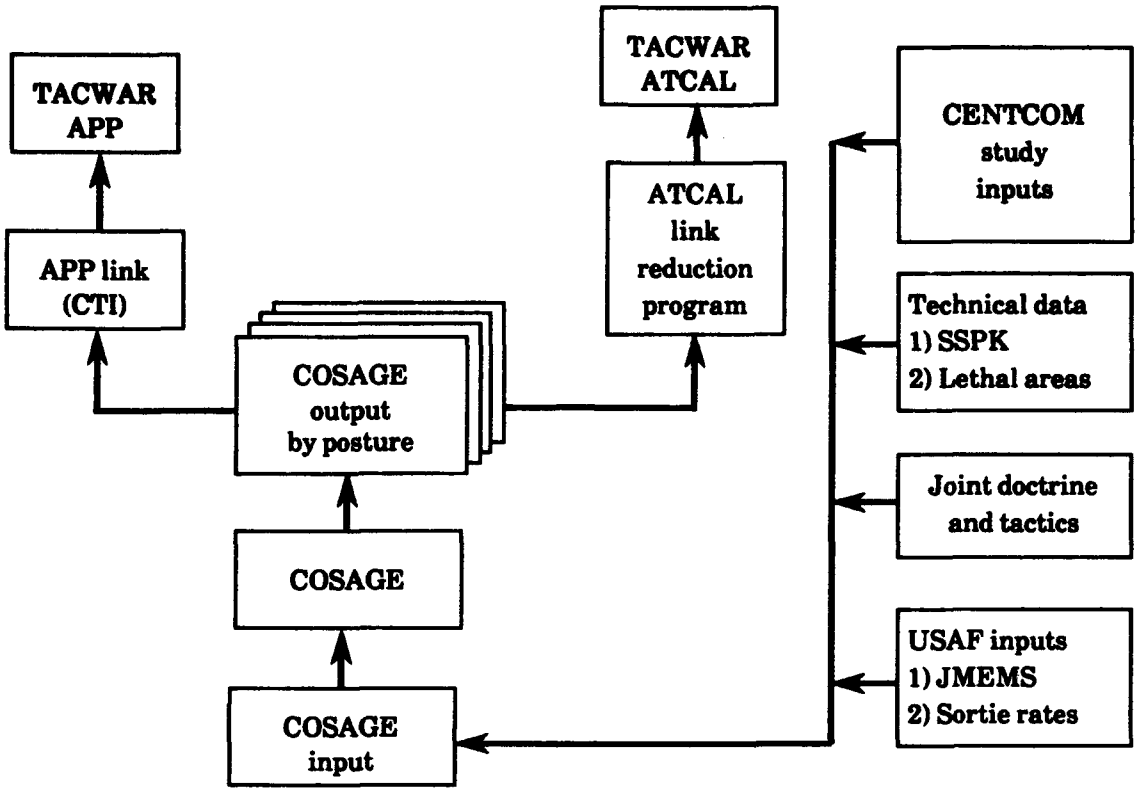

Figure 4-1. Audit Trail

4-2. EQUIPMENT INVENTORIES

a. Template Divisions. As mentioned in paragraph 4-1c, the unit equipment and force laydowns are developed from the template division forces and approved for use in this study. The actual MADCAP base case equipment inventories are contained in Appendix G.

b. Changes to Template Divisions. Inventories of the existing theater forces were provided by the study sponsor for use in this study. The desired timeframe required changes to the original template division inventories (derived from the WARREQ Major Regional Contingency - East (MRC-E) Study). Most of the changes involved the removal of projected equipment from the template and the replacement of that equipment with an existing or currently fielded weapon system. An example of these changes is the removal of the proposed US medium antitank missile (AAWS-M) and its replacement with additional, currently fielded, DRAGON antitank missiles. The result is an increase in the number of total US antitank systems on the battlefield but a less capable antitank force. The less potent force structure in turn affects how the unit fights in the simulation, and the results of the simulation change to reflect the new force and weapon structures.

c. **Inventory Accuracy**. Every effort is made to ensure the accuracy of the equipment and munition inventories. The study sponsor provided an inventory of weapon systems and munitions located in the theater of operations (Appendix G). Using this list and the approved weapon substitutions, an operational base case of weapon systems and munition types was developed. Actual sponsor-provided inventories were used whenever possible; there were occasions when changes to the inventory were made to ensure that a statistically valid number of direct fire ground weapons existed for each system category. Two methods are used to adjust the number of systems to a statistically correct amount:

- Increasing the number of weapons in a particular category by increasing the number of units in which that weapon can be found (increasing the number of weapons by increasing the number of units allows for the continued accurate employment of the system).
- Combining (or rolling up) the statistically insignificant weapon into another system of similar characteristics and manner of employment.

Before either method was selected, the study sponsor provided input on the best choice and approved the final selection. Table 4-2 contains the systems that were rolled up or increased in number for TACWAR. The COSAGE inventory rollup consists of the T54/T55 being rolled up into the T62.

Table 4-2. TACWAR Inventory Rollup

Force	Weapon type	Action taken
Blue	IFV/CFV/LAV/ITV	Rolled into antitank
	AH-64/AH-1/OH-58C,D	Rolled into attack helicopter
	155SP/155T/105T/203SP	Rolled into artillery
	A-10/AV-8/F-15E/F-15E/F-16/F-418	Rolled into TACAIR
Red	T72/T62	Rolled into tanks
	BRDM/BMP/BTR	Rolled into antitank
	HIP/HIND	Rolled into attack helicopter
	122MRDL/220MRL	Rolled into MLRS
	152SP/152T/122T/122SP/130mm/155T	Rolled into artillery
	SU-24/SU-25/MIG-27	Rolled into TACAIR

4-3. COSAGE-TACWAR INTERFACE

a. The CTI is designed to convert raw COSAGE output into a format that is TACWAR-usable and man-readable. CENTCOM and CAA development of this postprocessor occurred during Operation DESERT SHIELD. The intent was to assist CENTCOM in using combat sample data in their version of TACWAR. CENTCOM and CAA signed a Memorandum of Agreement to explore the capabilities of the CTI and then compare the resulting information against other alternatives. These alternatives included using TACWAR with ATCAL instead of the APP methodology. Published copies of this study are available through the CENTCOM Combat Analysis Group (CAG).

b. Output from the CTI processor was run and used as an analytical aid. Although this was the first attempt at using this analysis tool, it was recognized by CAA to be the key to verifying TACWAR attrition inputs.

CHAPTER 5

ANALYSIS

5-1. INTRODUCTION

a. All postcombat sample process analyses are used to meet internal CAA quality requirements for each scenario. These scenarios are postprocessed using a wide assortment of analytical tools and techniques. The results are compared against MOEs and EEAs listed below. These checks satisfy both tactical and operational considerations. The study team is unable to predict the acceptability of TACWAR output resulting from the use of combat sample data (operational PK, operational rates of fire, and allocation of fires) when used as TACWAR inputs. However, the operational data generated during this study will be incorporated into the CAA data base which houses all such parameters for follow-on comparative analysis.

b. Analysis of the COSAGE output is conducted against a series of approved EEAs and MOEs. Analysis guidelines are developed by CAA using historical data as a guide. These EEAs and MOEs require additional processing of the COSAGE data before any analysis is conducted. This analysis is transparent to the study sponsor. MADCAP uses three EEAs to evaluate the combat sample process output.

5-2. MEASURES OF EFFECTIVENESS

a. EEA 1. Do the forces follow sound doctrinal principles?

•• MOE for EEA 1

- FEBA movement.
- Shooter/victim ratios of major weapon systems.
- Relationship of combined arms contribution to joint operations.
- Suriving major weapon systems onhand over time.

b. EEA 2. Do the samples make sense from a tactical point of view?

•• MOE for EEA 2

- Force effectiveness.
- Historical comparison.

c. EEA 3. Are there appropriate and significant system interactions within the combat samples?

•• MOE for EEA 3

- Major weapon system losses over time.
- Apply standard benchmarks.

5-3. SYNOPSIS OF BATTLE

Intelligence Gathering

0000 Hours
Blue Mission - Perform reconnaissance missions
Red Mission - Perform reconnaissance missions
Blue forces employ JSTARS, UAVs, and satellite information systems to detect enemy forces. Red forces are extremely limited in obtaining intelligence on Blue forces to his front. (Although MADCAP combat samples do provide different levels of intelligence gathering, it is assumed that much of this function occurs before D-day.)

Preemptive Strikes

0030 Hours
Blue Mission - Obtain air superiority
Red Mission - Continue maneuver reconnaissance missions. Stay below ground in prepared bunkers, pillboxes, and defilade positions.

US Air Force assets begin to strike deep at preplanned targets, concentrating on high to medium air defense (HIMAD) systems. The objective is to clear a 50-kilometer wide corridor of HIMAD enemy air defense before committing to other priority missions.

0100 Hours
A battalion of Army aviation APACHE helicopters attack known HIMAD and short-range air defense (SHORAD) systems. Although not as deep as the Air Force strike, this also helps to achieve air superiority and helps to clear a lane 30 kilometers wide for the attacking two US divisions. This corridor will be the primary axis of attack.

Preparatory Artillery Fires

0130 Hours
Blue Mission - Fix the enemy
Red Mission - Continue maneuver reconnaissance. Stay below ground in prepared bunkers, pillboxes, and defilade positions.

The Blue doctrine employed in the MADCAP scenarios dictated that the use of preparatory fires (prep fire) by division and corps artillery assets is an integral part of a successful offensive action. Basically, the Blue commander hopes that his attack will be enhanced by the suppressing effect which his artillery provides. Additionally, any kills and harassment effects attributable to his artillery will multiply Blue maneuver force effectiveness. Therefore, the primary prep fire goals are:

a. Suppress the enemy while advancing.
b. Kill the enemy with prep fire.
c. Confuse the enemy with prep fire.

Blue prep fires are employed in the Blue attack Red prepared defense intense and Blue attack Red hasty defense. In both of these postures, Blue enjoys a 2:1 force ratio advantage. This Blue, heavy armor, attack scenario has approximately two Blue divisions assaulting a single Red division along a 30-kilometer front.

The first bombardment occurs against the Red screening force at 0130 hours and lasts for approximately 25 minutes. The second bombardment begins at 0200 hours and is directed against the aforementioned regiment along the main axis of attack. This second firing is mainly MLRS and lasts for approximately 25 minutes.

Locate and Disrupt/Defeat Enemy Reserve

0225 Hours
Blue Mission - Fix enemy center of gravity
Red Mission - Defend forward. Decisively engage and destroy attacking Blue forces in minefields.

USAF and Army aviation assets find the enemy reserve and begin to destroy it. These same assets attempt to locate and destroy threat launchers capable of firing chemical or tactial nuclear payloads.

Maneuver Assets Close: Phase I

0230 Hours
Blue Mission - Break through enemy barriers, obstacles, and minefields.
Red Mission - Commit strategic reserve to reinforce at point of enemy attack

Division number one proceeds forward to attempt a breach of employed obstacles and mines opposite the enemy regiment that received the earlier MLRS strikes.

It is assumed that the enemy has enough time to prepare substantial barriers and that defending forces have the will to fight.

Maneuver Assets Close: Phase II

1200 Hours
Blue Mission - Flank the enemy and destroy him
Red Mission - Maintain communication with forces being flanked. Provide available onhand reinforcing elements to slow attacker's momentum. Buy time.

Blue division number one breaches enemy minefields and barriers and holds approximately 10 kilometers beyond the stationed enemy regiments while the second division begins a flanking movement. [Aside; During DESERT STORM's Battle of 73 Easting, the 2d ACR moved some 200 kilometers through southern Iraq in less than 80 hours of periodic contact (average rate = 2.5 km/hr). However, they did not have to traverse berms, obstacles, or minefields. As a point of contrast, the 2d Division (Forward) during DESERT STORM's Battle of Norfolk traveled 170 kilometers in 90 hours because they had to deal with tank ditches, berms, and minefields (average rate = 118 km/hr).]

Red Withdraws: Phase I

2400 Hours
Blue Mission - Stay decisively engaged with the enemy
Red Mission - Red Division begins a fighting withdrawal

Blue has now advanced to a maximum of 30 kilometers beyond the breach. Due to USAF disruption of enemy reinforcements from the strategic reserve, Red has no choice but to withdraw. Under cover of darkness, Red leaves a small force to cover the withdrawal of his main body.

Red Withdraws: Phase II

3600 Hours
Blue Mission - Stay decisively engaged with the enemy
Red Mission - Reach alternative fighting positions

Red has now lost 60 percent of his fighting force. His withdrawal from the original positions cost him dearly as both USAF and Army aviation assets have hit him hard during his drive toward his secondary defensive positions. His SHORAD systems are not effective because of long air-to-ground engagement ranges coupled with Red's disintegrating force structure and command and control.

Battle Ends

4800 Hours
Red has lost 80 percent of his division. Blue has lost approximately 20 percent.
Blue has traveled 50 kilometers in 2 days of periodic fighting.

5-4. ANALYSIS OF EEA AND MOE. This paragraph discusses the analysis conducted on each EEA and their subsequent MOE. Some of the EEAs and MOEs are easily addressable using numerical analysis. These include such MOE as force ratios, system exchange ratios, and some of the "benchmarks." Other MOEs are not so easily addressed and in fact require a degree of subjective military analysis rather than pure numerical analysis. Such MOE include the demonstration of tactical force movement and analysis of combined arms operations. Below are the specific EEA and MOE followed by a discussion of the steps taken to analyze each of them.

a. EEA 1. Do the forces follow sound doctrinal principles? Doctrinal principles for US ground forces are drawn from standard manuals such as JCS Pub 3-0 and FM 100-5, Operations, dated June 1993. Discussions and technical meetings have also been held with members of the USAF. These standards accurately describe the proper functioning of specific units and organizations when engaged in combat on the modern battlefield. Additional manuals referenced are shown in Appendix C. Joint operations within the CENTCOM theater of operations required additional input from the CENTCOM CAG to ensure the proper employment, structure, and arming of the force.

(1) MOE for EEA 1

(a) FEBA Movement. Tactical force movement at unit level is determined by specific orders issued to each individual unit. These orders are devised to ensure that each unit moves in the manner appropriate for the mission and terrain. The movement of each unit is orchestrated to ensure command cohesion at every level of command. This MOE ensures that the tactical movement of each unit meets doctrinal tenets such as agility, initiative, depth, and synchronization. Divisional and brigade-sized forces are designed to operate with the same tactical requirements as the smaller units. All units found in each of the scenarios demonstrate correct

tactical operations. These operations are compared against the tenets found in FM 100-5 and JCS Pub 3-0.

(b) Shooter/Victim Ratios of Major Weapon Systems (see Table 4-1). Attacking and defending force ratios are significant in the determination of which side has the ability to attack and at what level the opponent will resist. These ratios are determined based on historical simulations and battles. The ratios represent the average attacker/defender ratios expected within the theater in question. According to doctrine, the ratios in Table 4-1 meet theater goals. In each case, the force ratio of each posture is determined during the development of the force laydown phase and provides the starting force ratios for each posture. These ratios concentrate on, but are not limited to, the primary combat systems.

(c) Relationship of Combined Arms Contribution to Joint Operations

1. Combined arms operations, for each of the different scenarios, are analyzed against existing documentation that outlines how units fight when fighting as a combined arms force. The three primary sources of documentation are JCS Pub 3-0, FM 100-5, Operations, and FM 100-15, Corps Operations. These manuals offer a good starting point for understanding and implementing the conceptual aspect of combined arms operations. Supplementing these manuals is the 71 series field manuals which provide important employment techniques and operational data for combined arms teams and task forces.

2. Joint operations required additional inputs from the study sponsor and the use of JCS Pub 3.0, Joint Operations. Joint operations are operations undertaken by a joint force commander in which forces of two or more services are involved. Joint operations are conducted in support of commander in chief (CINC) campaign plans to achieve all or part of their strategic or operational objective(s). Successful joint operations concentrate combat power, at all levels, that is greater than the sum of the components of the joint force. When properly organized and employed, the components of the joint force are more potent than if employed outside a joint framework.

3. For this study, joint operations were conducted between the Air Force and the Army. Tables 5-1 and 5-2 show the tactical aircraft and weapons configurations for both Blue and Red forces. These aircraft quantities and weapons configurations were prescribed by the study sponsor. Aircraft were employed in their appropriate roles. A-10s, AV-8s, and SU-25s were tasked primarily for close air support missions and were allocated against tanks and other targets located near forward edge of the battle area (FEBA). Short-range air interdiction (AI) missions were performed by F-16s and MIG-27s against long-range artillery positions and air defense sites. Longer-range AI missions were accomplished by F-15Es, F/A-18s, and SU-24s against airfields and command facilities. Resultant aircraft sortie rates, kills per sortie, and aircraft losses for the 48-hour campaign were compared with previous studies and other sources to ensure overall accuracy.

Table 5-1. Weapons Configuration - Blue

Aircraft	Number	Weapon	Number
A-10	7	AGM-65	4
		MK-20	1
		MK-82	3
		CBU-58	1
		30mm	N/A
F-16	12	AGM-65	1
		MK-20	1
		MK-82	4
		CBU-58	1
F-15E	4	AGM-65	2
		MK-20	3
		MK-82	2
		CBU-58	2
F/A-18	6	AGM-65	1
		MK-20	2
AV-8	6	AGM-65	1
		MK-82	1

Table 5-2. Weapons Configuration - Red

Aircraft	Number	Weapon	Number
SU-25	7	AS-14	1
		30mm	N/A
SU-24	2	AS-14	1
		500 L	2
MIG-27	9	AS-14	1
		30mm	N/A

4. This analysis concentrates on the organization and operations of specific units. Divisional combined arms operations use two or more types of units to support the larger divisional plan, and are characterized by the units acting independently of each other. Joint operations are similar, except that these operations include units

from two or more military services; e.g., US Air Force and US Army. The analysis found that simulated combat units performed in accordance with existing tenets of operations in every case. As an example of how the air battle was fought in conjunction with the study sponsor, a TACAIR employment table divided the battlefield up into areas into which each aircraft would fly with specific missions and targets (Figure 5-1).

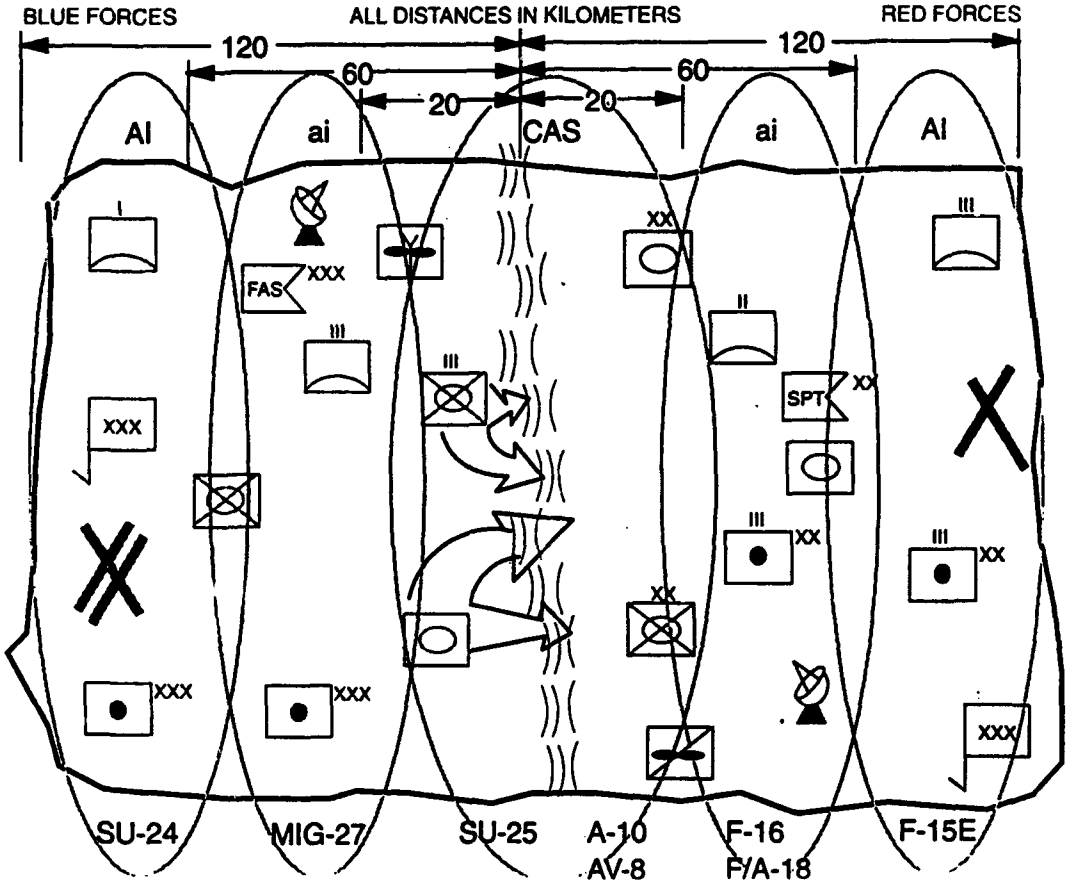

Figure 5-1. Tactical Air Employment

(d) Surviving Major Weapon Systems Onhand Over Time. This portion of the analysis concentrates on the specific units analyzed during the analysis of combined arms operations. In this phase of analysis, each unit is displayed at various times during the simulation. Visual displays of each unit provide an easy method of checking to ensure that each unit is performing in a manner consistent with its orders and missions. No anomalies were detected during this phase.

b. EEA 2. Do the samples make sense from a tactical point of view? This EEA requires the analysis of exchange ratios (SER, FER, and LER) of specific weapon systems. Another portion of the analysis for this EEA is checking for consistent and reasonable study results when compared to past studies of the same theater during the same timeframe.

(1) **MOE for EEA 2**

(a) Force Effectiveness. Analysis of tactical deployments and movements is based on a comparison of historical data of previous studies. Combat sample output data is used to calculate SER, FER, and LER for each posture. Table 5-3 shows SER, LER, and FER results. All formulas use selected major ground and air systems in their computations. These major ground and air system categories are listed in Table 5-4; all other systems are considered (for this analytical tool) to be nonmajor systems. Comparing these values to historical data provides an excellent check for study consistency. In each case, the determined SERs, FERs, and LERs are consistent with historical trends set by previous studies.

Table 5-3. SER/LER/FER Comparison (Blue attack - Red prepared defense posture)

Ratio	Equipment	MADCAP-1	
		Blue	Red
SER	Tank	.6	.9
	Antitank	.7	.3
	Artillery	10.6	.5
	MLRS	11.9	.1
	TACAIR	17.3	2.3
	Helicopter	13.4	2.3
FER	2.6		
LER	1.5		

1. **System Exchange Ratio.** The system exchange ratio helps to measure the effectiveness of each of the individual weapons systems used in the simulation. The system exchange ratio demonstrates how each weapon system compared to other systems that it killed or that killed it. SER is calculated both with and without kills of the Blue system by Red air systems when those systems are included in the denominator.

$$SER = \frac{Kills\ of\ all\ Red\ major\ ground\ systems\ by\ a\ single\ Blue\ sytem\ type}{Kills\ of\ that\ single\ Blue\ system\ type\ by\ all\ Red\ systems}$$

2. **Loss Exchange Ratio.** The LER provides a measure of how the total force structure of each side did when compared to their opponent. The LER is calculated both with and without kills of major ground systems by air systems of the opposing side.

$$LER = \frac{Kills\ of\ all\ Red\ major\ ground\ systems\ by\ all\ Blue\ system\ types}{Kills\ of\ all\ Blue\ major\ ground\ systems\ by\ all\ Red\ system\ types}$$

3. **Fractional Exchange Ratio.** The FER measures the relationship between the initial force ratio and the loss exchange ratio. The FER is calculated both with and without kills of major ground systems by enemy air systems.

$$FER = \frac{LER}{Initial\ major\ ground\ force\ ratio}$$

where the initial major ground force ratio is equal to:

$$\frac{Density\ of\ Red\ major\ ground\ systems}{Density\ of\ Blue\ major\ ground\ systems}$$

Table 5-4. Ground and Air Systems

Major ground systems	Major air systems
Tank	TACAIR
Antitank	
Artillery	
Helicopter	

(b) Historical Comparison. Compare results to past MRC-E studies. This MOE requires the effective combining of several other MOEs to ensure the overall success of the study when compared to previously approved studies. Areas that are compared include the following:

1. Initial starting inventories and force laydown for each scenario.
2. Final SER, LER, and FER figures for each scenario.
3. Operational probability of kill figures by vehicle and weapon system.
4. Operational rate of fire of each weapon system.
5. Firing allocation of each weapon system and platform.
6. Unit movement and order sets.

MADCAP comparisons against Operation DESERT SHIELD and previous CAA studies showed the MADCAP results to be consistent with these results. Table 5-5 shows the starting "*base case*" ratios of the major ground systems (identified in Table 5-4) for MADCAP-1.

Table 5-5. Base Case Force Ratios

System	MADCAP-1	
	Blue	Red
Tank	.7	1.0
Antitank	.9	1.0
Artillery	.8	1.0
Helicopter	2.8	1.0
Overall force ratio	.9	1.0

Table 5-6 shows operational PK and operational rates of fire for selected weapon systems. The data displayed in this table is drawn from the Blue attack/Red prepared defense intense posture but are typical of all postures. Complete operational PKs and firing allocations are available in Appendix D.

Table 5-6. Selected Operational PK and Rate of Fire (Blue attack/Red prepared defense intense)

Shooter	Target	Operational PK MADCAP-1	Firing rate/ 12 hours
M1A1 (Blue)	T-62	.2	.1
M1A1	T-72	.2	.1
T-62 (Red)	M1A1	.1	.7
T-72	M1A1	.1	.8

c. EEA 3. Are there appropriate and significant system interactions within the combat samples? This EEA requires the use of another combat sample postprocess, the killer/victim matrix, and the application of a series of significant historical data points, called "benchmarks."

(1) MOE for EEA 3

(a) Major Weapon System Losses Over Time. Interactions within the combat sample process are checked by using a postprocessed killer/victim matrix. This matrix shows all of the engagements that occurred within the simulation. These engagements are shown as kills against a specific victim. The objective of the matrix

is to ensure that there are appropriate and significant interactions between weapon systems that are expected to engage each other. For example, US M1A1 tanks are expected to engage threat T-72 tanks. To ensure that there are appropriate and significant interactions between these two weapons systems, one has only to look at the killer/victim matrix to ensure these interactions took place and in what quantity. The matrix shows the number of M1A1s (victim) killed by T-72s (killer) and the number of T-72s (victim) killed by M1A1s (killer). That is an example of two weapon systems that are expected to engage each other on the battlefield. An example of two weapon systems that are not expected to engage on the battlefield are the US STINGER antiaircraft missile and the North Korean 152mm towed artillery piece. In the case of these two systems, a sparse killer/victim matrix is expected. CENTCOM provided valuable feedback in all facets of the review process, but especially in the interaction arena. Many discussions concerning firer/target interactions were held between CENTCOM and CAA throughout this study. Examples can be found in Appendix I. All postures show appropriate and significant interactions within the combat sample process.

(b) Apply Standard Benchmarks Listed in Table 5-7. These truth traps are the result of many years of producing combat samples and tracking the results of these samples. These are standards that provide guidance to ensure the combat sample process does not have any incorrect inputs or invulnerable systems. Each of these truth traps is compared against each scenario's postprocessed output. Results from each posture successfully meet each of these checks. The only area that poses some concern is the exchange ratio of attack helicopters. The US attack helicopter exchange ratios are slightly higher than the 20:1 (helicopter kills to helicopters killed) ratio used as a guideline. Further investigation revealed that the lack of a sophisticated antiaircraft missile system within the threat inventory allowed both Cobra and Apache missions to be conducted with impunity. The threat antiaircraft inventory is made up of antiaircraft guns and cannons. The result of this is a slightly higher US helicopter exchange ratio of about 24:1.

Table 5-7. Benchmarks

All major systems interact with each other.
No major killing system invulnerable.
Artillery expenditures >20 and <200 rounds/tube/day.
Tank expenditures >0 and <15 rounds/tank/day.
Tank antitank rounds/kill >2 and <15.
Fraction lost of major systems roughly equal on both sides.
Exchange ratios of like systems in logical order.
TACAIR attrition <10% per sortie.
Exchange ratio of attack helicopters is >3 and <20.
Smart munition rounds/kill <4.
Median range of engagement for tanks and AFVs <2,000 meters.
Fraction lost of major system <.[a]

[a]To be determined according to sponsor input. In this case, CENTCOM was interested in a short, violent confrontation during which time it might not be unusual to see threat losses at the 70-80 percent level and for US forces to reach a steady state of 20-30 percent over 48 hours.

5-5. ANALYSIS OF THE CTI OUTPUT. Analysis of this data is extremely difficult due to the limited historical data available for comparison. Because this segment of the analysis process is new, CAA had no automated way to analyze data produced by the CTI. The data is checked to ensure that the CTI program produced the required TACWAR inputs in a format that is accepted by TACWAR (see paragraph 4-3c for a new recommended approach).

CHAPTER 6

SUMMARY

6-1. SUMMARY. The process of producing the operational probability of kill, the operational rate of fire, and the firing allocation for each weapon system is straightforward. The degree of success achieved by this data when used as inputs for TACWAR is evident by customer satisfaction. Past experience with combat samples developed for CENTCOM indicate that TACWAR will continue to function properly while using the combat samples as input. However, there may be some output which requires further investigation. The effect of combat samples in TACWAR is the topic of another study. As the CTI represents such an import step in the COSAGE-TACWAR process, it is recommended that CAA build an automated CTI editor to streamline the process of verifying the TACWAR inputs of:

- Operational PK
- Firing allocation
- Rate of fire

Currently, audit for "reasonableness" is done manually. The checking of these inputs can be made more efficient and less time-consuming by a computer program designed to do this job automatically.

6-2. FOLLOW-ON STUDIES. Additional follow-on studies to provide combat sample data for other TACWAR studies are expected (see paragraph 6-4, Recommendations). These studies will continue to build on the fundamental structure laid down by MADCAP and Operations DESERT SHIELD/STORM studies. Work is currently underway for TACWAR users at J-8 CFAD, European Command (EUCOM), and Deputy Chief of Staff for Operations and Plans (DCSOPS) Program Acquisition and Evaluation (PA&E).

6-3. CONCLUSIONS

a. The Blue force armed with technologically superior weapon systems will soundly defeat a technologically inferior threat force. Major players were aircraft of the United States Air Force, the M1A1 Abrams main battle tank, the Apache helicopter, the Bradley fighting vehicle, and the multiple launch rocket system (MLRS) rocket artillery. The synergisms of these combat arms working in concert give good estimates of operational weapon systems performance as depicted in Table 5-3.

b. Each EEA has been reviewed and has been successfully met. Each measure of effect has been discussed with the study sponsor and has been demonstrated either on site or through other appropriate forums.

APPENDIX A

STUDY CONTRIBUTORS

1. STUDY TEAM

a. Study Directors

CPT Robert A. Powell and MAJ Robert S. Elias, Force Evaluation Directorate

b. Team Members

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APPENDIX B

STUDY DIRECTIVE

UNITED STATES CENTRAL COMMAND
MACDILL AIR FORCE BASE, FLORIDA 33621-5101

6 November 1992

MEMORANDUM FOR DIRECTOR, U.S. ARMY CONCEPTS ANALYSIS AGENCY,
8120 WOODMONT AVENUE, BETHESDA, MD 20814

SUBJECT: Development of Combat Samples for TACWAR

1. REFERENCE: TACWAR Attrition Analysis - Phase II (TACAAN II) Analysis Review Board, Concepts Analysis Agency, 2 Nov 92.

2. PURPOSE. This memorandum establishes objectives and provides guidance for the conduct of the study approved by the reference.

3. BACKGROUND. The Combat Analyis Group (CCCA), U.S. Central Command, has undertaken the task of updating their Tactical Warfare (TACWAR) attrition database for their OPLAN 1002-95. CCCA has requested through the Deputy Under Secretary of the Army for Operations Research (DUSA-OR) that CAA provide necessary combat samples.

4. STUDY SPONSOR. Combat Analysis Group, U.S. Central Command, through the DUSA-OR. Point of contact is Mr. Joel Banks.

5. STUDY AGENCY. U.S. Army Concepts Analysis Agency

6. TERMS OF REFERENCE.

a. Objective. The objective of this study is to produce OPLAN 1002-95 combat samples for use in TACWAR.

b. Scope. Develop combat samples for various combat postures.

c. Miscellaneous. N/A

7. RESPONSIBILITIES.

a. CAA - Force Evaluation Directorate (FE).

(1) Develop combat samples for use in TACWAR. These combat samples will assist CCCA by providing a data audit trail. The following samples by posture are needed:

Blue Attack Red Hasty Defense
Blue Attack Red Prepared Defense
Blue Attack Red Delay

Red Attack Blue Hasty Defense
Red Attack Blue Prepared Defense
Red Attack Blue Delay
Static

(2) Provide a final report.

D. CENTCOM - Combat Analysis Group (CCCA). Provide written guidance for scenario development, including order of battle, tactical employment of ground and air forces, equipment inventories, and weapon mixes.

8. ADMINISTRATION.

Milestones.

Study Guidance and Study Plan	20 Nov 92
Initial Analyis Review Board	8 Dec 92
Data Collection and Research	1 Jan 93
Initiation of Execution/Analysis	1 Jan 93
Interim Review	12 Jan 93
Final Analysis Review Board	26 Jan 93
External Review and Report Preparation	28 Feb 93

RAYFORD M. EUBANKS
LTC(P), USA
Chief, Combat Analysis Group

APPENDIX C

BIBLIOGRAPHY

DEPARTMENT OF THE ARMY

Department of the Army Publications

FM 1-100, Doctrinal Principles for Army in Combat Operations (UNCLASSIFIED)

FM 1-112, Tactics, Techniques, and Procedures for the Attack Helicopter Battalion (UNCLASSIFIED)

FM 6-20, Fire Support in The AirLand Battle (UNCLASSIFIED)

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FM 71-1, Tank and Mechanized Infantry Company Team (UNCLASSIFIED)

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ATCAL: An Attrition Model Using Calibrated Parameters, CAA-TP-83-3 August 1983 (UNCLASSIFIED)

Combat Sample Generator (COSAGE) User's Manual, Volume II - Input/Output Guide, CAA-D-93-1, April 1993 (UNCLASSIFIED)

Wartime Requirements Analysis SWA, FY 1995 (WARREQ-95M), CAA-SR-93-10 (to be published) (SECRET-NOFORN)

APPENDIX D

OPERATIONAL SHOT DATA

Operational shot data is to be published separately for US CENTCOM, Combat Analysis Group. Contact the Theater and Campaign Analysis Directorate, Tactical Analysis Division, ATTN: CPT Powell, for access to its contents.

APPENDIX E

MASTER DEFINITION LIST

The master definition list is a listing of definitions for COSAGE equipment, weapons, and munitions. This listing has been included for interpretation of COSAGE equipment, weapons, and munitions in Appendices F and G. When cross-referencing from Appendices F and G, it may be necessary to drop the U (US) or R (threat) prefix to locate specific information in Appendix E.

U.S. ARMY CONCEPT ANALYSIS AGENCY
COSAGE MASTER DEFINITION LIST SORTED BY
DEF, TYPE, & COSAGE NAME
AS OF 06 JAN 1994

COSAGE NAME	S	TYPE	COUNTRY	DEFINITION
_ACA10	C	EQUIP	US	ACFT, A-10A, WART HOG CLOSE AIR SUPPORT
_ACF5	C	EQUIP	US	ACFT, A-5, CLOSE AIR SUPPORT
_ACA7	C	EQUIP	US	ACFT, A7, HIGH PERF
_ACA7A	C	EQUIP	US	ACFT, A7A, HIGH PERF
_ACA7B	C	EQUIP	US	ACFT, A7B, HIGH PERF
_AN12	C	EQUIP	RUSSIAN	ACFT, AN12, HIGH PERF
NACCAS	O	EQUIP	NATO	ACFT, CLOSE AIR SUPPORT
_AC111	C	EQUIP	US	ACFT, F-111, HIGH PERF
_A111A	C	EQUIP	US	ACFT, F-111A, HIGH PERF
_ACF15	C	EQUIP	US	ACFT, F-15, HIGH PERF
_AC15E	C	EQUIP	US	ACFT, F-15E, HIGH PERF
_ACF16	C	EQUIP	US	ACFT, F-16, HIGH PERF
_AC16A	C	EQUIP	US	ACFT, F-16A, HIGH PERF
_AC16B	C	EQUIP	US	ACFT, F-16B, HIGH PERF
_ACF4D	C	EQUIP	US	ACFT, F4D11, HIGH PERF
_ACF4G	C	EQUIP	US	ACFT, F4G, HIGH PERF
_ACF4M	C	EQUIP	US	ACFT, F4M, HIGH PERF
_ACA11	C	EQUIP	US	ACFT, GENERIC, HIGH PERF
_MIG15	C	EQUIP	NKOREAN	ACFT, MIG15, HIGH PERF
_MIG21	C	EQUIP	RUSSIAN	ACFT, MIG21, HIGH PERF
_MIG25	C	EQUIP	RUSSIAN	ACFT, MIG25, HIGH PERF
_MIG27	C	EQUIP	RUSSIAN	ACFT, MIG27, HIGH PERF
_MIG29	C	EQUIP	RUSSIAN	ACFT, MIG29, HIGH PERF
_SU17	C	EQUIP	RUSSIAN	ACFT, SU17, HIGH PERF
_SU17A	C	EQUIP	RUSSIAN	ACFT, SU17A, HIGH PERF
_SU17G	C	EQUIP	RUSSIAN	ACFT, SU17G, HIGH PERF
_SU24	C	EQUIP	RUSSIAN	ACFT, SU24, HIGH PERF, W/250 & 500KG BOMB
_SU24G	C	EQUIP	RUSSIAN	ACFT, SU24G, HIGH PERF, W/250 & 500KG BOMB
_SU25	C	EQUIP	RUSSIAN	ACFT, SU25, HIGH PERF, W/30MM CANNON, 250KG BOMB
_SU27	C	EQUIP	NKOREAN	ACFT, SU27, HIGH PERF, W/30MM CANNON, 250KG BOMB
_SU7	C	EQUIP	RUSSIAN	ACFT, SU7, HIGH PERF
YSU85	O	EQUIP	CHINESE	ACFT, SU85, HIGH PERF
_TU16A	C	EQUIP	RUSSIAN	ACFT, TU16A, HIGH PERF
_TU16B	C	EQUIP	RUSSIAN	ACFT, TU16B, HIGH PERF
_TU16C	C	EQUIP	RUSSIAN	ACFT, TU16C, HIGH PERF
_TU22M	C	EQUIP	NKOREAN	ACFT, TU22M, HIGH PERF
_YAK28	C	EQUIP	RUSSIAN	ACFT, YAK28, HIGH PERF
_ADATS	C	EQUIP	US	AD & AT, FUTURE SYSTEM
_Z30-X	C	EQUIP	RUSSIAN	AD, 30MM CANNON & SA-19 (2S6 FORMERLY ZSU-X), SP
KDUSTZ	C	EQUIP	SKOREAN	AD, CANNON, TWIN 40MM, SP, M42 DUSTER
XAT100	O	EQUIP	NKOREAN	AD, GUN, 100MM, TOWED
_A100A	C	EQUIP	RUSSIAN	AD, GUN, 100MM, TOWED
YAD14A	O	EQUIP	CHINESE	AD, GUN, 14.5MM, TOWED
_VULCZ	C	EQUIP	US	AD, GUN, 20MM, VULCAN, SP
_ZU23A	C	EQUIP	RUSSIAN	AD, GUN, 23MM, TOWED
_ADGP2	C	EQUIP	GERMAN	AD, GUN, 35MM, GEPARD 2
KADM45	O	EQUIP	SKOREAN	AD, GUN, 35MM, OERLIKON, M45D (SWISS)
KM45DA	C	EQUIP	SKOREAN	AD, GUN, 35MM, OERLIKON, M45D (SWISS)
_ADAGN	C	EQUIP	NATO	AD, GUN, 35MM, OERLIKON, M45D (SWISS)
_AD37A	C	EQUIP	RUSSIAN	AD, GUN, 37MM, TOWED
KADT40	C	EQUIP	SKOREAN	AD, GUN, 40MM, TWIN
XAS60A	O	EQUIP	NKOREAN	AD, GUN, 57MM, TOWED S60
_AD57A	C	EQUIP	RUSSIAN	AD, GUN, 57MM, TOWED S60
_DVADZ	O	EQUIP	US	AD, GUN, DIVAD
_ZPU2A	C	EQUIP	RUSSIAN	AD, GUN, TWIN 14.5MM, ZPU-2, TOWED

_ADGP1	C	EQUIP GERMAN	AD, GUN, TWIN 20MM, GEPARD 1
_VULCA	C	EQUIP US	AD, GUN, VULCAN, TOWED
IZ572Z	C	EQUIP IRANIAN	AD, GUN, ZS2-57-2, SP (23-4 DATA)
_Z234Z	C	EQUIP RUSSIAN	AD, GUN, ZSU, QUAD 23MM, SP
_Z232A	C	EQUIP RUSSIAN	AD, GUN, ZU, TWIN 23MM, TOWED
_HMVST	C	EQUIP US	AD, HUMMV W/PEDESTAL-MTD STINGER (AVENGER)
ULADS	O	EQUIP US	AD, LIGHT SYS
_ZPU4	O	EQUIP RUSSIAN	AD, MG, QUAD 14.5MM, ZPU-4, TOWED
_ZPU4A	C	EQUIP RUSSIAN	AD, MG, QUAD 14.5MM, ZPU-4, TOWED
KQ50V	O	EQUIP SKOREAN	AD, MG, QUAD 50CAL, VEH-MTD
_ADQ50	C	EQUIP SKOREAN	AD, MG, QUAD 50CAL, VEH-MTD
_CHAPZ	C	EQUIP US	AD, MISSILE, CHAPARRAL, SP
_HAWK	C	EQUIP US	AD, MISSILE, HAWK
_ICHPZ	C	EQUIP US	AD, MISSILE, IMPROVED CHAPARRAL, SP
_HAWKI	C	EQUIP US	AD, MISSILE, IMPROVED HAWK
NNIKE	C	EQUIP NATO	AD, MISSILE, NIKE SYS
_PATRI	C	EQUIP US	AD, MISSILE, PATRIOT SYS
_ASA11	C	EQUIP RUSSIAN	AD, MISSILE, SA-11
_ASA12	C	EQUIP RUSSIAN	AD, MISSILE, SA-12 (SA4 DATA)
_ASA13	C	EQUIP RUSSIAN	AD, MISSILE, SA-13
_SA14F	C	EQUIP RUSSIAN	AD, MISSILE, SA-14 FOLLOW ON (STINGER DATA)
_ASA15	C	EQUIP RUSSIAN	AD, MISSILE, SA-15
_ASA2	O	EQUIP RUSSIAN	AD, MISSILE, SA-2
_ASA3	C	EQUIP RUSSIAN	AD, MISSILE, SA-3
_ASA4	C	EQUIP RUSSIAN	AD, MISSILE, SA-4
_ADSA6	C	EQUIP RUSSIAN	AD, MISSILE, SA-6
_ASA6	O	EQUIP RUSSIAN	AD, MISSILE, SA-6
_ADSA8	C	EQUIP RUSSIAN	AD, MISSILE, SA-8
_ASA9	C	EQUIP RUSSIAN	AD, MISSILE, SA-9
_ASA9V	C	EQUIP RUSSIAN	AD, MISSILE, SA-9, VEH-MTD
NADORL	O	EQUIP NATO	AD, ROLAND
NADROL	C	EQUIP NATO	AD, ROLAND
_SA7F	O	EQUIP RUSSIAN	AD, SA-7F
_ASX15	C	EQUIP RUSSIAN	AD, SA-X-15, SAM LAUNCHER
_PMSTG	O	EQUIP US	AD, STINGER, VEH-MTD (AVENGER) [SAME AS HMVST]
MAAV	C	EQUIP US	APC, ARMORED ASSUALT VEH, MARINE CORP
NAPCHV	O	EQUIP NATO	APC, ARMORED CAR
IBMP1	O	EQUIP IRANIAN	APC, BMP1M W/AT-3 ATGM & 73MM GUN
_BTR50	C	EQUIP RUSSIAN	APC, BTR50
_BTR60	C	EQUIP RUSSIAN	APC, BTR60 W/14.5MM MG & 7.62MM MG
_BTR70	C	EQUIP RUSSIAN	APC, BTR70 W/14.5MM MG & 7.62MM MG
NAPC8	O	EQUIP NATO	APC, FARRET(B), AFV432, SPARTAN, SULTAN, VAR, M113
_FBTR	C	EQUIP RUSSIAN	APC, FBTR W/AT-P-9 ATGM & 50MM GUN (BTR80 FOLLOW ON)
NAPC7	O	EQUIP GENRIC	APC, FOR US & NATO
NAPC4	O	EQUIP NATO	APC, FRENCH VPX
_FBMP3	C	EQUIP RUSSIAN	APC, FUTURE BMP
_FBMP1	C	EQUIP RUSSIAN	APC, FUTURE BMP1M W/AT-P-9 ATGM & 50MM GUN
_113	O	EQUIP US	APC, M113
_M113	O	EQUIP US	APC, M113
_113A1	C	EQUIP US	APC, M113A1
MM113	C	EQUIP US	APC, M113A1, MARINE CORP
UMCA1	O	EQUIP US	APC, M113A1, MARINE CORP
_113BM	C	EQUIP US	APC, M113A1, W/25MM BUSHMASTER
_APC19	C	EQUIP US	APC, M113A1, W/MARK 19 GL
_113A2	C	EQUIP US	APC, M113A2
UMCPC2	O	EQUIP US	APC, MARINE CORP
NAPC5	O	EQUIP NATO	APC, SPARTAN
YAPC63	O	EQUIP CHINESE	APC, TYPE 63
YAPC64	O	EQUIP CHINESE	APC, TYPE 64
YAPC67	O	EQUIP CHINESE	APC, TYPE 67
XAPC73	O	EQUIP NKOREAN	APC, TYPE 732
XAPCAT	O	EQUIP NKOREAN	APC, W/AT
NAPCAN	O	EQUIP NATO	APC, W/CANNON
NAPHOT	C	EQUIP NATO	APC, W/HOT MISSILE

_APCMG	C	EQUIP	RUSSIAN	APC, W/MG
_APMG	O	EQUIP	NATO	APC, W/MG
NAPMIL	O	EQUIP	NATO	APC, W/MILAN MISSILE
NAPMLN	C	EQUIP	NATO	APC, W/MILAN MISSILE
_H105A	C	EQUIP	US	ARTY, 105MM, HOW M119, L199, M101A1, M102A1, TOWED
NH105Z	C	EQUIP	NATO	ARTY, 105MM, HOW, SP
_H120Z	C	EQUIP	RUSSIAN	ARTY, 120MM, HOW, SP
_H120D	C	EQUIP	RUSSIAN	ARTY, 120MM, HOW, SP, USED AS A DIRECT FIRE EQUIP
_G122Z	C	EQUIP	RUSSIAN	ARTY, 122MM, GUN, SP
_G122A	C	EQUIP	RUSSIAN	ARTY, 122MM, GUN, TOWED
_H122Z	C	EQUIP	RUSSIAN	ARTY, 122MM, HOW, SP
_H122D	C	EQUIP	RUSSIAN	ARTY, 122MM, HOW, SP, USED AS A DIRECT FIRE EQUIP
_H122A	C	EQUIP	RUSSIAN	ARTY, 122MM, HOW, TOWED
_G130Z	C	EQUIP	RUSSIAN	ARTY, 130MM, GUN, SP
_G130A	C	EQUIP	RUSSIAN	ARTY, 130MM, GUN, TOWED
_G152Z	C	EQUIP	RUSSIAN	ARTY, 152MM, GUN, SP
_G152A	C	EQUIP	RUSSIAN	ARTY, 152MM, GUN, TOWED
_H152Z	C	EQUIP	RUSSIAN	ARTY, 152MM, HOW, SP
_H152D	C	EQUIP	RUSSIAN	ARTY, 152MM, HOW, SP, USED AS A DIRECT FIRE EQUIP
_H152A	C	EQUIP	RUSSIAN	ARTY, 152MM, HOW, TOWED
KH155B	C	EQUIP	SKOREAN	ARTY, 155MM, HOW (T)K179-INDIG.-LIKE US M198, TOWED
_H155Z	C	EQUIP	US	ARTY, 155MM, HOW M109A2 HIP, SP
_H155P	C	EQUIP	US	ARTY, 155MM, HOW M109A6, PALADIN, SP
_H155A	C	EQUIP	US	ARTY, 155MM, HOW M198, TOWED
UMC155	O	EQUIP	US	ARTY, 155MM, HOW M198, TOWED, MARINE CORP
_G160A	C	EQUIP	RUSSIAN	ARTY, 160MM, GUN, TOWED
_G170Z	C	EQUIP	NKOREAN	ARTY, 170MM, GUN, SP, KOKSUN
_G175Z	C	EQUIP	SKOREAN	ARTY, 175MM, GUN, SP
_H175Z	C	EQUIP	IRANIAN	ARTY, 175MM, HOW, SP
XG180Z	C	EQUIP	NKOREAN	ARTY, 180MM, GUN, SP
_G203Z	C	EQUIP	RUSSIAN	ARTY, 203MM, GUN, SP
_G76A	C	EQUIP	RUSSIAN	ARTY, 76MM, GUN, TOWED
_H203Z	C	EQUIP	US	ARTY, 8IN, HOW M110A2, SP
_H203A	C	EQUIP	US	ARTY, 8IN, HOW M115, TOWED
UAFAS	C	EQUIP	US	ARTY, ADVANCED FIELD ARTY SYSTEM
_ATCMS	C	EQUIP	US	ARTY, MISSILE, ATACMS
_SCUDS	C	EQUIP	RUSSIAN	ARTY, MISSILE, SCUD
_FROG	C	EQUIP	RUSSIAN	ARTY, MISSILE, SURF TO SURF, FROG
_G76MA	C	EQUIP	RUSSIAN	ARTY, MOUNTAIN GUN, 76MM, TOWED
_MLRS	C	EQUIP	US	ARTY, MULTI RKT LAUNCHER
_L122V	C	EQUIP	RUSSIAN	ARTY, MULTI RKT LAUNCHER, 122MM, MRL, SP
_130ML	C	EQUIP	SKOREAN	ARTY, MULTI RKT LAUNCHER, 130MM
_L220V	C	EQUIP	RUSSIAN	ARTY, MULTI RKT LAUNCHER, 220MM, MRL, SP
_L280V	C	EQUIP	RUSSIAN	ARTY, MULTI RKT LAUNCHER, 280MM, MRL, SP
_MLRS1	C	EQUIP	GERMAN	ARTY, MULTI RKT LAUNCHER, FIRING ICM
_MLRSD	O	EQUIP	US	ARTY, MULTI RKT LAUNCHER, FIRING SADARM
_FOGML	C	EQUIP	US	ARTY, MULTI RKT LAUNCHER, FOG-M (NLOS)
_L107Z	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 107MM, SP
_L107A	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 107MM, TOWED
_L122Z	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 122MM, BM21, SP
_L122A	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 122MM, TOWED
YL130V	O	EQUIP	CHINESE	ARTY, RKT LAUNCHER, 130MM, SP
_L140A	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 140MM, TOWED
_L220Z	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 220MM, SP
_L222Z	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 222MM, SP (220 SP DATA)
_L240Z	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 240MM, SP
_L240A	C	EQUIP	RUSSIAN	ARTY, RKT LAUNCHER, 240MM, TOWED
_FOG-M	C	EQUIP	US	AT, FOG-M (NLOS)
_ATT12	C	EQUIP	RUSSIAN	AT, GUN, 100MM, T-12 (MT-12)
_G100A	O	EQUIP	RUSSIAN	AT, GUN, 100MM, TOWED
_SPAT	C	EQUIP	RUSSIAN	AT, GUN, 125MM, SP
_AT85Z	C	EQUIP	RUSSIAN	AT, GUN, 85MM, SP
_AT85A	C	EQUIP	RUSSIAN	AT, GUN, 85MM, TOWED
XATM39	O	EQUIP	NKOREAN	AT, GUN, M-39

_T12FO	O	EQUIP	RUSSIAN	AT, GUN, T12 FOLLOW ON
XJPTOW	O	EQUIP	SKOREAN	AT, JEEP, W/TOW
_JEPTW	C	EQUIP	US	AT, JEEP, W/TOW
NAPC6	O	EQUIP	NATO	AT, JPK-M6-TANK DESTROYER
NAPC1	O	EQUIP	NATO	AT, JPZ I/II W/HOT JAGUAR
ULOSAT	C	EQUIP	US	AT, LINE-OF-SIGHT SYSTEM
_113TW	C	EQUIP	US	AT, M113, W/TOWI
_ITV	C	EQUIP	US	AT, W/IMPROVED TOW
XCRAT4	O	EQUIP	NKOREAN	CREW, AT-4
XCRMG	O	EQUIP	NKOREAN	CREW, MG
_CRWMG	C	EQUIP	GENERIC	CREW, MG
NCRTOW	C	EQUIP	NATO	CREW, W/TOW II
_CRWWP	C	EQUIP	US	CREW, WEAPONS CREWMAN
_GLLD	O	EQUIP	RUSSIAN	GRD LASER DESIG
_GLLDT	C	EQUIP	US	GRD LASER DESIG, NON-HMMWV-MTD
_GLLDV	C	EQUIP	US	GRD LASER DESIG, VEH-MTD (HMMWV)
_GLLDG	C	EQUIP	US	GRD LASER DESIG, W/7.62MG, VEH-MTD (HMMWV)
_HCA1J	C	EQUIP	SKOREAN	HELO, ATK, AH-1J
_HCAH1	C	EQUIP	US	HELO, ATK, AH-1S
_ACAH1	C	EQUIP	US	HELO, ATK, AH-1S, CROSS FLOT MODE
UMHAH1	O	EQUIP	US	HELO, ATK, AH-1S, MARINE CORP
_HCH64	C	EQUIP	US	HELO, ATK, AH-64
_ACH64	C	EQUIP	US	HELO, ATK, AH-64, CROSS FLOT MODE
_HCL64	C	EQUIP	US	HELO, ATK, AH-64, W/LONG BOW
_ACL64	C	EQUIP	US	HELO, ATK, AH-64, W/LONG BOW, CROSS FLOT MODE
_HCH66	C	EQUIP	US	HELO, ATK, AH-66 COMMANCHE
_HAVOC	C	EQUIP	RUSSIAN	HELO, ATK, FOLLOW-ON TO HIND-E
_HIPE	C	EQUIP	RUSSIAN	HELO, ATK, HEAVY ARMOR, HIP-E
_HINDD	C	EQUIP	RUSSIAN	HELO, ATK, HIND-D
_HINDE	C	EQUIP	RUSSIAN	HELO, ATK, HIND-E
XHIP	O	EQUIP	NKOREAN	HELO, ATK, HIP
_HIPC	C	EQUIP	RUSSIAN	HELO, ATK, LT ARMOR, HIP-C
_HOAH6	C	EQUIP	US	HELO, ATK, OAH6
_HAH58	C	EQUIP	US	HELO, ATK, OH-58D
NHCAT2	C	EQUIP	NATO	HELO, ATK, W/20MM CANNON
NHCHOT	C	EQUIP	NATO	HELO, ATK, W/HOT MISSILE
NHCCG	O	EQUIP	NATO	HELO, CARGO
_HC47C	O	EQUIP	US	HELO, CARGO, CH-47C
AHIPFO	C	EQUIP	US	HELO, FORWARD OBSERVER & DESIGNATOR
NHCATK	C	EQUIP	FRENCH	HELO, GAZELLE, FRCH ALLOUETTE I/II, GERMAN BO-105
_HOOK	O	EQUIP	RUSSIAN	HELO, HOOK
_HOPLT	C	EQUIP	RUSSIAN	HELO, HOP-LITE, W/AT-3
_HOPL2	C	EQUIP	NKOREAN	HELO, HOP-LITE, W/AT-5
_LHX	C	EQUIP	US	HELO, LIGHT ATK, EXPERM'TL (FROM AH-1S DATA)
XHC500	C	EQUIP	SKOREAN	HELO, SCOUT
NSCOUT	C	EQUIP	NATO	HELO, SCOUT
_HCLHX	C	EQUIP	US	HELO, SCOUT, LHX
_ACLHX	C	EQUIP	US	HELO, SCOUT, LHX, CROSS FLOT MODE
_HC58C	C	EQUIP	US	HELO, SCOUT, OH-58C
_HC58D	C	EQUIP	US	HELO, SCOUT, OH-58D
_AC58D	C	EQUIP	US	HELO, SCOUT, OH-58D, CROSS FLOT MODE
_H58D2	C	EQUIP	US	HELO, SCOUT, OH-58D2, LASER DESIGNATOR
_HCH1S	C	EQUIP	SKOREAN	HELO, SCOUT, UH-1H
_HCH1H	C	EQUIP	US	HELO, UTIL, UH-1H
_UH1H	O	EQUIP	US	HELO, UTIL, UH-1H
XHCH1J	C	EQUIP	SKOREAN	HELO, UTIL, UH-1J
_HCH60	C	EQUIP	US	HELO, UTIL, UH-60 BLACKHAWK
_HOKUM	C	EQUIP	RUSSIAN	HELO, W/AT-6 AIR-TO-AIR MISSILE, KA-50 WEREWOLF
_HC5TW	C	EQUIP	SKOREAN	HELO, W/TOW
_BMD	C	EQUIP	RUSSIAN	IFV, BMD, AIRBORNE COMBAT
_BMD-2	C	EQUIP	RUSSIAN	IFV, BMD-2, AIRBORNE COMBAT, (BMD FOLLOW-ON)
YBMPT	O	EQUIP	CHINESE	IFV, BMP (RECON)
_BMPR	C	EQUIP	RUSSIAN	IFV, BMP 1976/1 W/73MM GUN & 7.62MM MG (RECON)
_BMP3M	C	EQUIP	RUSSIAN	IFV, BMP1M W/AT-3 ATGM & 73MM GUN

_BMP2	C	EQUIP RUSSIAN	IFV, BMP2
_BMP2G	C	EQUIP RUSSIAN	IFV, BMP2G W/30MM GUN
_BMP5M	C	EQUIP RUSSIAN	IFV, BMP2M W/AT-5 ATGM & 30MM GUN
KIFV	O	EQUIP SKOREAN	IFV, INF FIGHTING
_FIFV	C	EQUIP US	IFV, INF FIGHTING, FUTURE MODEL
_M2IFV	C	EQUIP US	IFV, INF FIGHTING, M2
UMCIFV	O	EQUIP US	IFV, INF FIGHTING, M2, MARINE CORP
_M2A2	C	EQUIP US	IFV, INF FIGHTING, M2A2
_M2A2I	O	EQUIP US	IFV, INF FIGHTING, M2A2, IMPROVED
_M2A2S	C	EQUIP US	IFV, INF FIGHTING, M2A2, W/STINGER
_IFV25	C	EQUIP SKOREAN	IFV, INF FIGHTING, W/25MM BUSHMASTER
_IFV50	C	EQUIP SKOREAN	IFV, INF FIGHTING, W/50CAL MG
_IFVTW	C	EQUIP SKOREAN	IFV, INF FIGHTING, W/TOW
NAPC3	O	EQUIP NATO	IFV, MARDER
_ADAM	C	EQUIP US	MINE, AIR DELIVERED
FASCAM	O	EQUIP US	MINE, FAMILY OF SCATTERABLE MINES
RDSCAM	O	EQUIP RUSSIAN	MINE, FAMILY OF SCATTERABLE MINES
_FASCM	C	EQUIP GENERIC	MINE, FAMILY OF SCATTERABLE MINES
_FSCAM	O	EQUIP US	MINE, FAMILY OF SCATTERABLE MINES
FASCAZ	C	EQUIP GENERIC	MINE, FASCAM MINES FIRED FROM SP ARTY
FASCAA	C	EQUIP GENERIC	MINE, FASCAM MINES FIRED FROM TOWED ARTY
GEMMFD	O	EQUIP US	MINE, GEMMS MINE FLD
_GEMMS	C	EQUIP US	MINE, GEMMS MINE FLD
REDMFD	O	EQUIP RUSSIAN	MINE, MINE FLD
AIRMFD	C	EQUIP US	MINE, VOLCANO AIR DELIVERED
MINEFD	O	EQUIP GENERIC	MINEFIELD - ALL COUNTRIES
_MNFLD	C	EQUIP GENERIC	MINEFIELD - ALL COUNTRIES
_M120A	C	EQUIP US	MORTAR, 120MM, GRD-MTD
_M120M	C	EQUIP RUSSIAN	MORTAR, 120MM, MAN-PACK
_M120Z	C	EQUIP US	MORTAR, 120MM, SP
YM160V	O	EQUIP CHINESE	MORTAR, 160MM, SP
_M160Z	C	EQUIP RUSSIAN	MORTAR, 160MM, SP
_M160A	C	EQUIP RUSSIAN	MORTAR, 160MM, TOWED
_M240Z	C	EQUIP RUSSIAN	MORTAR, 240MM, SP, MZ005
_M240A	C	EQUIP RUSSIAN	MORTAR, 240MM, TOWED
NM4.2M	O	EQUIP NATO	MORTAR, 4.2IN
_M107A	C	EQUIP US	MORTAR, 4.2IN, GD-MTD (CARRIED IN A GAMMA GOAT)
_M107	O	EQUIP US	MORTAR, 4.2IN, SP
_M107Z	C	EQUIP US	MORTAR, 4.2IN, SP
XMT60A	C	EQUIP NKOREAN	MORTAR, 60MM
_M-60M	C	EQUIP US	MORTAR, 60MM, LIGHT WEIGHT, M19 MAN-PACK
RM-60M	C	EQUIP RUSSIAN	MORTAR, 60MM, LIGHT WEIGHT, MAN-PACK
YM60Z	O	EQUIP CHINESE	MORTAR, 60MM, SP
_M-81Z	C	EQUIP US	MORTAR, 81MM, M125, SP
_M-81M	C	EQUIP US	MORTAR, 81MM, MTR MAN-PACK
_M-82M	C	EQUIP RUSSIAN	MORTAR, 82MM, MAN-PACK
YM82Z	O	EQUIP CHINESE	MORTAR, 82MM, SP
_M-82Z	C	EQUIP RUSSIAN	MORTAR, 82MM, SP
XMT82A	C	EQUIP NKOREAN	MORTAR, 82MM, TOWED M1937/M42
YOP105	O	EQUIP CHINESE	OPERATOR, 105MM, RECOILESS RIFLE
YOP12	O	EQUIP CHINESE	OPERATOR, 12.7MM MG
_OP76A	C	EQUIP RUSSIAN	OPERATOR, 76MM, GUN, TOWED
NOP82R	O	EQUIP NATO	OPERATOR, 82MM, RECOILESS RIFLE
YOP82	O	EQUIP CHINESE	OPERATOR, 82MM, RECOILESS RIFLE
_OP90G	C	EQUIP GENERIC	OPERATOR, 90RR, M67
_RR90G	O	EQUIP US	OPERATOR, 90RR, M67
_OP57R	C	EQUIP GENERIC	OPERATOR, AD, GUN, 57MM
_OPAT4	C	EQUIP GENERIC	OPERATOR, AT-4
_OPAT5	C	EQUIP RUSSIAN	OPERATOR, AT-5
_OPAT7	C	EQUIP RUSSIAN	OPERATOR, AT-7
_OPAT3	C	EQUIP RUSSIAN	OPERATOR, AT3
_OPAWS	C	EQUIP US	OPERATOR, AWSSM
_OPDRG	C	EQUIP US	OPERATOR, DRAGON
_OPAGS	C	EQUIP RUSSIAN	OPERATOR, GL, AGS17

XOPGL	C	EQUIP	NKOREAN	OPERATOR, GRENADE LAUNCHER
_OPLAW	C	EQUIP	US	OPERATOR, LAW
_OP50G	C	EQUIP	US	OPERATOR, M2, 50CAL MG, GRD-MTD
_OP203	C	EQUIP	US	OPERATOR, M203 GRENADE LAUNCHER
_OP60G	C	EQUIP	US	OPERATOR, M60, 7.62MM
_OPM79	C	EQUIP	US	OPERATOR, M79 GREANADIER
_OPMG	C	EQUIP	GENERIC	OPERATOR, MG
_OPMIL	C	EQUIP	NATO	OPERATOR, MILAN ATGM, GM
_OP19G	C	EQUIP	US	OPERATOR, MK19 GRENADE LAUNCHER
_OP107	C	EQUIP	NATO	OPERATOR, MORTAR, 4.2IN
NOPPZF	C	EQUIP	NATO	OPERATOR, PANZERFAUST ATGM, GM
_OP3.5	C	EQUIP	GENERIC	OPERATOR, RECOILESS RIFLE, 3.5IN (LAW DATA)
_OPB10	C	EQUIP	RUSSIAN	OPERATOR, RECOILESS RIFLE, 82MM, B-10
_OPRED	C	EQUIP	SKOREAN	OPERATOR, REDEYE, MAN-PACK
_OPRPG	C	EQUIP	RUSSIAN	OPERATOR, RPG
_OPR16	C	EQUIP	RUSSIAN	OPERATOR, RPG16
_OPRP7	C	EQUIP	RUSSIAN	OPERATOR, RPG7
_OPS14	C	EQUIP	RUSSIAN	OPERATOR, SA-14
_ASA16	C	EQUIP	RUSSIAN	OPERATOR, SA-16
_OPR7	O	EQUIP	RUSSIAN	OPERATOR, SA-7
_OPSA7	C	EQUIP	RUSSIAN	OPERATOR, SA-7
XOPSAM	O	EQUIP	NKOREAN	OPERATOR, SAM
_OP16F	C	EQUIP	RUSSIAN	OPERATOR, SAM-16F
_OPSAW	C	EQUIP	US	OPERATOR, SQUAD, AUTOMATIC
_OPSTG	C	EQUIP	US	OPERATOR, STINGER, MAN-PACK
_OPTOW	C	EQUIP	US	OPERATOR, TOW, GRD-MTD
_OPVIP	C	EQUIP	US	OPERATOR, VIPER
_RDA37	C	EQUIP	RUSSIAN	RADAR, 37MM, AD GUN, TOWED
_RDA57	C	EQUIP	RUSSIAN	RADAR, 57MM, AD GUN, TOWED
_BFRED	C	EQUIP	RUSSIAN	RADAR, CM/CB, BIG FRED
_BFRDF	C	EQUIP	RUSSIAN	RADAR, CM/CB, BIG FRED FOLLOW ON
_SYAWN	C	EQUIP	RUSSIAN	RADAR, CM/CB, YAWN
_FYAWN	C	EQUIP	RUSSIAN	RADAR, CM/CB, YAWN FOLLOW ON
_TPQ36	C	EQUIP	US	RADAR, COUNTER MORTAR
_TPQ37	C	EQUIP	US	RADAR, COUNTER MORTAR
_FLASH	C	EQUIP	GENERIC	RADAR, FLASH/SOUND
_RDHWK	C	EQUIP	US	RADAR, HAWK
_PSNRY	C	EQUIP	RUSSIAN	RADAR, MAN-PACK, PSNR-Y FOLLOW ON
_RDPAT	C	EQUIP	US	RADAR, PATRIOT
UPPD15	O	EQUIP	US	RADAR, PERSONNEL DETECTING
_PPS15	C	EQUIP	US	RADAR, PERSONNEL DETECTING
_RDA11	C	EQUIP	RUSSIAN	RADAR, SA-11
_RDA12	C	EQUIP	RUSSIAN	RADAR, SA-12
_RDSA4	C	EQUIP	RUSSIAN	RADAR, SA-4
_RDSA6	C	EQUIP	RUSSIAN	RADAR, SA-6
_PPS-5	C	EQUIP	US	RADAR, SMALL
_SOUND	C	EQUIP	GENERIC	RADAR, SOUND RANGING
_PZKSD	C	EQUIP	RUSSIAN	RADAR, SOUND, PZK
_PZKFS	C	EQUIP	RUSSIAN	RADAR, SOUND, PZK FOLLOW ON
_SFRED	C	EQUIP	RUSSIAN	RADAR, SURVEILLANCE, SMALL FRED
_SFRDF	C	EQUIP	RUSSIAN	RADAR, SURVEILLANCE, SMALL FRED FOLLOW ON
Y105RR	O	EQUIP	CHINESE	RECOILESS RIFLE, 105MM, GRD-MTD
_RR106	C	EQUIP	GENERIC	RECOILESS RIFLE, 106MM, GRD-MTD
_JP106	C	EQUIP	SKOREAN	RECOILESS RIFLE, 106MM, JEEP-MTD
_SPG-9	C	EQUIP	RUSSIAN	RECOILESS RIFLE, 73MM, GRD-MTD, SPG-9
Y75RR	O	EQUIP	CHINESE	RECOILESS RIFLE, 75MM, GRD-MTD
_ATB10	O	EQUIP	RUSSIAN	RECOILESS RIFLE, 82MM, B-10
NLUCHS	C	EQUIP	NATO	RECON, 20MM & 7.62MG, AMPH RECON (GE), LUCHS
_BRDM1	C	EQUIP	RUSSIAN	RECON, BRDM1 W/12.7MM MG & 7.62MM MG
_BRDM4	C	EQUIP	RUSSIAN	RECON, BRDM1 W/AT-3 ATGM, 12.7MM MG & 7.62MM MG
_FBRDM	C	EQUIP	RUSSIAN	RECON, BRDM2 FOLLOW-ON W/AT-P-9 ATGM & 50MM GUN
_BRDM2	C	EQUIP	RUSSIAN	RECON, BRDM2 W/14.5MM MG & 7.62MM MG
_BRDM3	C	EQUIP	RUSSIAN	RECON, BRDM2 W/AT-3 ATGM & 14.5MM MG
_BRDM5	C	EQUIP	RUSSIAN	RECON, BRDM2 W/AT-5 ATGM & 14.5MM MG

_M3CFV	C	EQUIP	US	RECON, CAV FIGHTING, M3
_HMV25	C	EQUIP	US	RECON, HMMWV W/25MM BUSHMASTER & 76MM MG
_HMV50	C	EQUIP	US	RECON, HMMWV W/50CAL MG
_HMV19	C	EQUIP	US	RECON, HMMWV W/MARK 19
_HMVT1	C	EQUIP	US	RECON, HMMWV W/TOW 1
_HMVT2	C	EQUIP	US	RECON, HMMWV W/TOW II
_LAV25	C	EQUIP	US	RECON, LIGHT ARMD, W/25MM BUSHMASTER
_JSTAR	C	EQUIP	US	RPV, FUTURE
_RPV	C	EQUIP	GENERIC	RPV, REMOTELY PILOTED VEHICLE
RPV	O	EQUIP	US	RPV, REMOTELY PILOTED VEHICLE ACQUILA
_TNS10	O	EQUIP	US	SENSOR, GRD-MTD
_T55/4	C	EQUIP	RUSSIAN	TANK, 100MM, T54/55
_T55R	C	EQUIP	RUSSIAN	TANK, 100MM, T55, W/REACTIVE ARMOR
_T59	C	EQUIP	NKOREAN	TANK, 100MM, T59
FRAMX	C	EQUIP	FRENCH	TANK, 105MM, AMX30/B2
_AMX30	C	EQUIP	FRENCH	TANK, 105MM, AMX30/B2
_AMX32	C	EQUIP	FRENCH	TANK, 105MM, AMX32
UAGS	C	EQUIP	US	TANK, 105MM, ARMORED GUN SYSTEM (LIGHT TANK)
_LEO1	C	EQUIP	GERMAN	TANK, 105MM, LEOPARD I
_M1	C	EQUIP	US	TANK, 105MM, M1
UMCM1	O	EQUIP	US	TANK, 105MM, M1, MARINE CORP
UMM1	O	EQUIP	US	TANK, 105MM, M1, MARINE CORP
M48A5	O	EQUIP	SKOREAN	TANK, 105MM, M48A5
_M48A5	C	EQUIP	SKOREAN	TANK, 105MM, M48A5
_60A1	C	EQUIP	US	TANK, 105MM, M60A1
_60A3	C	EQUIP	US	TANK, 105MM, M60A3
_M60A3	C	EQUIP	US	TANK, 105MM, M60A3
K105IT	C	EQUIP	SKOREAN	TANK, 105MM, ROK INDIG TNK
KROKIT	O	EQUIP	SKOREAN	TANK, 105MM, ROK INDIG TNK
_T62	C	EQUIP	RUSSIAN	TANK, 115MM, T62
_T62R	C	EQUIP	RUSSIAN	TANK, 115MM, T62, W/REACTIVE ARMOR
_CHALL	C	EQUIP	BRITISH	TANK, 120MM, CHALLENGER
_CHIEF	C	EQUIP	BRITISH	TANK, 120MM, CHIEFTAIN
_LEO2	C	EQUIP	GERMAN	TANK, 120MM, LEOPARD II
_M1A1	C	EQUIP	US	TANK, 120MM, M1A1
_M1A2	C	EQUIP	US	TANK, 120MM, M1A2
_M1A3	C	EQUIP	US	TANK, 120MM, M1A3
K120IT	C	EQUIP	SKOREAN	TANK, 120MM, ROK INDIG TNK
_T64A	C	EQUIP	RUSSIAN	TANK, 125MM, T64
_T72	C	EQUIP	RUSSIAN	TANK, 125MM, T72
_T72R	C	EQUIP	RUSSIAN	TANK, 125MM, T72, W/REACTIVE ARMOR
_T80	C	EQUIP	RUSSIAN	TANK, 125MM, T80, (M1981/3), W/ATGM
_T80B	C	EQUIP	RUSSIAN	TANK, 125MM, T80, (M1981/3), W/ATGM & REACTIVE ARMOR
_PT76	C	EQUIP	RUSSIAN	TANK, 76MM, PT76 (LIGHT TANK)
_SCPN	C	EQUIP	IRANIAN	TANK, 76MM, SCORPION LIGHT TANK
IM47	O	EQUIP	IRANIAN	TANK, 90MM, M47
_M48	O	EQUIP	SKOREAN	TANK, 90MM, M48A1/A2/A3 & M47
_M4890	C	EQUIP	SKOREAN	TANK, 90MM, M48A1/A2/A3 & M47
_T64B	C	EQUIP	RUSSIAN	TANK, AT-8 MISSILE, T64
_FST	C	EQUIP	RUSSIAN	TANK, FUTURE #1 (ITAC DETERMINES THE MAKE-UP OF IT)
_FST-I	O	EQUIP	RUSSIAN	TANK, FUTURE #1 (ITAC DETERMINES THE MAKE-UP OF IT)
_FST1	O	EQUIP	RUSSIAN	TANK, FUTURE #1 (ITAC DETERMINES THE MAKE-UP OF IT)
_FST2	O	EQUIP	RUSSIAN	TANK, FUTURE #2 (ITAC DETERMINES THE MAKE-UP OF IT)
_FSTII	C	EQUIP	RUSSIAN	TANK, FUTURE #2 (ITAC DETERMINES THE MAKE-UP OF IT)
_FST3	O	EQUIP	RUSSIAN	TANK, FUTURE #3 (ITAC DETERMINES THE MAKE-UP OF IT)
UBKIII	C	EQUIP	US	TANK, FUTURE BLOCK III
_M551	C	EQUIP	US	TANK, SHERIDAN
YT34	O	EQUIP	CHINESE	TANK, T34
YT69	O	EQUIP	CHINESE	TANK, T69
_ADTP	C	EQUIP	GENERIC	TROOP, AD
_AO	O	EQUIP	GENERIC	TROOP, AERIAL OBSERVER
_AOTP	C	EQUIP	GENERIC	TROOP, AERIAL OBSERVER
_INTEL	C	EQUIP	GENERIC	TROOP, ALL SOURCE INTEL, DEEP TGTS
_ATTP	C	EQUIP	GENERIC	TROOP, AT

_FATP	C	EQUIP	GENERIC	TROOP, FIELD ARTY
YFO	O	EQUIP	CHINESE	TROOP, FORWARD OBSERVER
_FAFO	C	EQUIP	GENERIC	TROOP, FORWARD OBSERVER
_FOTP	C	EQUIP	GENERIC	TROOP, FORWARD OBSERVER
_HQTP	C	EQUIP	GENERIC	TROOP, HEADQUARTERS
_INTP	C	EQUIP	GENERIC	TROOP, INFANTRY
_L-TP	C	EQUIP	GENERIC	TROOP, LAUNCHER
_SUPTP	C	EQUIP	GENERIC	TROOP, LOGISTICS
KLRRP	C	EQUIP	SKOREAN	TROOP, LONG RANGE RECON PATROL
_M-TP	C	EQUIP	GENERIC	TROOP, MORTAR
_INOB	C	EQUIP	US	TROOP, UNTRAINED OBSERVER
NACTOR	O	EQUIP	NATO	UNKNOWN
NAD12A	O	EQUIP	NATO	UNKNOWN
NAPC	O	EQUIP	NATO	UNKNOWN
NSHAIN	O	EQUIP	NATO	UNKNOWN
NSHANI	O	EQUIP	NATO	UNKNOWN
RHALO	O	EQUIP	RUSSIAN	UNKNOWN
RHARAN	O	EQUIP	RUSSIAN	UNKNOWN
RHRAN	O	EQUIP	RUSSIAN	UNKNOWN
RRD44A	O	EQUIP	RUSSIAN	UNKNOWN
RSU85Z	O	EQUIP	RUSSIAN	UNKNOWN
RTRAC	O	EQUIP	RUSSIAN	UNKNOWN
RTRKAT	O	EQUIP	RUSSIAN	UNKNOWN
UFS155	O	EQUIP	US	UNKNOWN
UMPG	O	EQUIP	US	UNKNOWN
XSOFE	O	EQUIP	NKOREAN	UNKNOWN
_OPR18	O	EQUIP	RUSSIAN	UNKNOWN
_TRKAT	O	EQUIP	NKOREAN	UNKNOWN
_548	O	EQUIP	US	VEH, AMMO CARRIER
_M548	C	EQUIP	US	VEH, AMMO CARRIER
XCMDVH	O	EQUIP	NKOREAN	VEH, CMD & CONTROL
_C&CVH	C	EQUIP	GENERIC	VEH, CMD & CONTROL
_577CP	C	EQUIP	US	VEH, CMD POST, M577
_FAVH	C	EQUIP	GENERIC	VEH, FIELD ARTY
_FDCVH	C	EQUIP	GENERIC	VEH, FIRE DIRECTION CENTER
_FISTV	C	EQUIP	US	VEH, FIRE SUPPORT (M113A1 APC)
_FOVH	C	EQUIP	RUSSIAN	VEH, FORWARD OBSERVER
_M88	C	EQUIP	US	VEH, HVY RECOVERY, M88
_JEEP	C	EQUIP	US	VEH, JEEP
_MRTVH	C	EQUIP	RUSSIAN	VEH, MORTAR
_TRUCK	C	EQUIP	GENERIC	VEH, TRUCK
NTRK5T	O	EQUIP	NATO	VEH, TRUCK, 5T
_HMMWV	C	EQUIP	US	VEH, UTILITY, HMMWV
R250B	C	MUNS	RUSSIAN	BOMB, 250KG
U20MK	C	MUNS	US	BOMB, 250LB, ROCKEYE
R500B	C	MUNS	RUSSIAN	BOMB, 500KG
U82MK	C	MUNS	US	BOMB, 500LB
U82MKH	C	MUNS	US	BOMB, 500LB, HIGH DRAG
M404	C	MUNS	SKOREAN	PROJO, 105MM, ANTI-PERSONNEL ONLY ICM
M444	C	MUNS	US	PROJO, 105MM, ANTI-PERSONNEL ONLY ICM
XM915	C	MUNS	US	PROJO, 105MM, DPICM
M1	C	MUNS	US	PROJO, 105MM, HE
XM913	C	MUNS	US	PROJO, 105MM, HE RAP
M314A2	C	MUNS	US	PROJO, 105MM, ILLUM
M84B1	C	MUNS	US	PROJO, 105MM, SMOKE
M329A2	C	MUNS	US	PROJO, 107MM (4.2IN), HE
M335	C	MUNS	US	PROJO, 107MM (4.2IN), ILLUM
M328	C	MUNS	US	PROJO, 107MM (4.2IN), SMOKE
M120HE	C	MUNS	RUSSIAN	PROJO, 120MM, HE
M120IL	C	MUNS	RUSSIAN	PROJO, 120MM, ILLUM
XM930	C	MUNS	US	PROJO, 120MM, ILLUM
M120SM	C	MUNS	RUSSIAN	PROJO, 120MM, SMOKE
XM929	C	MUNS	US	PROJO, 120MM, SMOKE
H122HE	C	MUNS	RUSSIAN	PROJO, 122MM, HE

122FLE	C	MUNS	RUSSIAN	PROJO, 122MM, HE, FLESHETTE
H122HF	C	MUNS	RUSSIAN	PROJO, 122MM, HIGH FRAG
H122IL	C	MUNS	RUSSIAN	PROJO, 122MM, ILLUM
H122SM	C	MUNS	RUSSIAN	PROJO, 122MM, SMOKE
XM934	C	MUNS	US	PROJO, 120MM, HE
G130HE	C	MUNS	RUSSIAN	PROJO, 130MM, HE
130MRL	C	MUNS	SKOREAN	PROJO, 130MM, HE, MRL
G130IL	C	MUNS	RUSSIAN	PROJO, 130MM, ILLUM
G130SM	C	MUNS	RUSSIAN	PROJO, 130MM, SMOKE
RDHD	C	MUNS	RUSSIAN	PROJO, 152MM, COPPERHEAD
RDRAAM	C	MUNS	RUSSIAN	PROJO, 152MM, FASCAM
G152HE	C	MUNS	RUSSIAN	PROJO, 152MM, HE
H152HE	C	MUNS	RUSSIAN	PROJO, 152MM, HE
122RAP	C	MUNS	RUSSIAN	PROJO, 152MM, HE RAP
152RAP	C	MUNS	RUSSIAN	PROJO, 152MM, HE RAP
152FLE	C	MUNS	RUSSIAN	PROJO, 152MM, HE, FLESHETTE
H152HF	C	MUNS	RUSSIAN	PROJO, 152MM, HIGH FRAG
152ICM	C	MUNS	RUSSIAN	PROJO, 152MM, ICM
H152IC	C	MUNS	RUSSIAN	PROJO, 152MM, ICM
H152IL	C	MUNS	RUSSIAN	PROJO, 152MM, ILLUM
H152SM	C	MUNS	RUSSIAN	PROJO, 152MM, SMOKE
M449	C	MUNS	US	PROJO, 155MM, ANTI-PERSONNEL ICM
M712	C	MUNS	US	PROJO, 155MM, COPPERHEAD
M483A1	C	MUNS	US	PROJO, 155MM, DPICM
RAAM-A	C	MUNS	US	PROJO, 155MM, FASCAM
RAAM-K	C	MUNS	SKOREAN	PROJO, 155MM, FASCAM
M107	C	MUNS	US	PROJO, 155MM, HE
M795	C	MUNS	US	PROJO, 155MM, HE
XM864	C	MUNS	US	PROJO, 155MM, HE BASEBURNER
M549A1	C	MUNS	US	PROJO, 155MM, HE RAP
M485A2	C	MUNS	US	PROJO, 155MM, ILLUM
RM898	C	MUNS	RUSSIAN	PROJO, 155MM, SADARM
XM898	C	MUNS	US	PROJO, 155MM, SADARM
M825	C	MUNS	US	PROJO, 155MM, SMOKE
M160HE	O	MUNS	US	PROJO, 160MM, HE
M160IL	O	MUNS	US	PROJO, 160MM, ILLUM
M160SM	O	MUNS	US	PROJO, 160MM, SMOKE
M437	C	MUNS	SKOREAN	PROJO, 175MM, HE
G180HE	C	MUNS	RUSSIAN	PROJO, 180MM, HE
G203HE	C	MUNS	RUSSIAN	PROJO, 203MM, HE
203RAP	C	MUNS	RUSSIAN	PROJO, 203MM, HE RAP
220ICM	C	MUNS	RUSSIAN	PROJO, 220MM, ICM, MRL
L220HE	C	MUNS	RUSSIAN	PROJO, 220MM, MRL
M240HE	C	MUNS	RUSSIAN	PROJO, 240MM, HE
M60HE	C	MUNS	US	PROJO, 60MM, HE
M720	C	MUNS	US	PROJO, 60MM, HE
M721	C	MUNS	US	PROJO, 60MM, ILLUM
M83A3	C	MUNS	US	PROJO, 60MM, ILLUM
M302A1	C	MUNS	US	PROJO, 60MM, SMOKE
M722	C	MUNS	US	PROJO, 60MM, SMOKE
L32E1	O	MUNS	US	PROJO, 81MM, HE
M374A3	C	MUNS	SKOREAN	PROJO, 81MM, HE
M821	C	MUNS	US	PROJO, 81MM, HE
XM853	C	MUNS	US	PROJO, 81MM, ILLUM
XM819	C	MUNS	US	PROJO, 81MM, SMOKE
M82HE	C	MUNS	RUSSIAN	PROJO, 82MM, HE
M82IL	C	MUNS	RUSSIAN	PROJO, 82MM, ILLUM
M82SM	C	MUNS	RUSSIAN	PROJO, 82MM, SMOKE
M106	C	MUNS	US	PROJO, 8IN, HE
M650	C	MUNS	US	PROJO, 8IN, HE RAP
M509A1	C	MUNS	US	PROJO, 8IN, ICM
SCUHDS	C	MUNS	RUSSIAN	PROJO, COPPERHEAD
L107HE	C	MUNS	RUSSIAN	WARHEAD, 107MM, HE, RKT
L122HE	C	MUNS	RUSSIAN	WARHEAD, 122MM, RKT

L240HE	C	MUNS	RUSSIAN	WARHEAD, 240MM, RKT
MLRSA	C	MUNS	US	WARHEAD, ATACMS
TGWMUN	O	MUNS	US	WARHEAD, ATGM
MLRS	C	MUNS	US	WARHEAD, ICM
M26SDM	C	MUNS	US	WARHEAD, SADARM
MLRSD	O	MUNS	US	WARHEAD, SADARM
SSDRMS	C	MUNS	RUSSIAN	WARHEAD, SADARM
_AA100	O	WPN	RUSSIAN	100MM, AD GUN
_AT100	C	WPN	RUSSIAN	100MM, AT GUN, T-12 (MT-12)
YRR105	O	WPN	CHINESE	105MM, RECOILESS RIFLE
_106RR	C	WPN	SKOREAN	106MM, RECOILESS RIFLE
_H120W	C	WPN	RUSSIAN	120MM, ARTY TUBE, HOW, USED AS A DIRECT FIRE WPN
_H122W	C	WPN	RUSSIAN	122MM, ARTY TUBE, HOW, USED AS A DIRECT FIRE WPN
_AT125	C	WPN	RUSSIAN	125MM, AT GUN
RAA14	O	WPN	RUSSIAN	14.5MM, AD GUN, TWIN, ZPU-2
_AA14T	C	WPN	RUSSIAN	14.5MM, AD GUN, TWIN, ZPU-2
_H152W	C	WPN	RUSSIAN	152MM, ARTY TUBE, HOW, USED AS A DIRECT FIRE WPN
_R275	C	WPN	US	2.75IN, RKT
F1020	C	WPN	FRENCH	20MM, AUTOMATIC, AMX-10
_CA20H	C	WPN	US	20MM, CANNON, AH-1S HELO-MTD
NROHS	O	WPN	NATO	20MM, HS-30 APC
_LUC20	C	WPN	GERMAN	20MM, LUCHS ARV
_MARCE	C	WPN	GERMAN	20MM, MARDER IFV
F1320	C	WPN	FRENCH	20MM, TWIN, AMX-13
_RH202	O	WPN	GERMAN	20MM, TWIN, RH-202 TRACKED
NCA20V	C	WPN	NATO	20MM, VEH-MTD
_VULC	C	WPN	US	20MM, VULCAN
_CA23H	C	WPN	RUSSIAN	23MM, HELO-MTD
_AA234	C	WPN	RUSSIAN	23MM, QUAD, ZSU-23-4, SP
_AA23T	C	WPN	RUSSIAN	23MM, TWIN, ZSU-23-2, TOWED
_CA23V	C	WPN	RUSSIAN	23MM, VEH-MTD
_GUN25	C	WPN	US	25MM, GUN, BUSHMASTER
M11325	O	WPN	BELGIAN	25MM, IFV, M113A1
D76525	O	WPN	NETHERLAND	25MM, IFV, YPR-765
UCA30H	C	WPN	US	30MM, CANNON, AH-64 HELO-MTD
UC30AC	C	WPN	US	30MM, CANNON, GAU8 HIGH PERF ACFT A-5 & A-10
RCA30H	C	WPN	RUSSIAN	30MM, CANNON, HELO-MTD
RC30AC	C	WPN	RUSSIAN	30MM, CANNON, HIGH PERF ACFT SU25
NFOX30	O	WPN	NATO	30MM, FOX RECON (WHEELED)
NMCV80	O	WPN	NATO	30MM, MCV-80
NC30V	O	WPN	NATO	30MM, SCOUTCAR FERRET
_AA30Z	C	WPN	RUSSIAN	30MM, SP (2S6 FORMERLY ZSU-X)
FAM30T	C	WPN	FRENCH	30MM, TWIN, AMX-30
_CA30V	C	WPN	RUSSIAN	30MM, VEH-MTD
_AD35A	C	WPN	NATO	35MM, AD GUN, OERLIKON (SWEDISH BUILT)
_GEP35	C	WPN	GERMAN	35MM, AD, GEPARD
_AA37	C	WPN	RUSSIAN	37MM, AD GUN
_DIVAD	O	WPN	US	40MM, AD GUN, DIVAD, SGT YORK
NAABOF	O	WPN	NATO	40MM, AD GUN, L40/L60/BOFFI
_M203	C	WPN	US	40MM, GREN LCHR, M203 RIFLE-MTD
IGLM79	O	WPN	IRANIAN	40MM, GREN LCHR, M79 (203 DATA)
KAD40	C	WPN	SKOREAN	40MM, TWIN, DUSTER
_AKS74	C	WPN	RUSSIAN	5.45MM, RIFLE, AKS-74
NRIF5.	O	WPN	NATO	5.56MM, RIFLE
_M16A1	C	WPN	US	5.56MM, RIFLE, M16A1
_M16A2	C	WPN	US	5.56MM, RIFLE, M16A2
_SAW5.	C	WPN	US	5.56MM, RIFLE, SQUAD AUTOMATIC
KAD50	C	WPN	SKOREAN	50CAL, AD MG, QUAD
_CA50V	C	WPN	RUSSIAN	50MM, GUN, VEH-MTD (FUTURE VEH W/TURRETS)
_AA57	C	WPN	RUSSIAN	57MM, AD GUN
_RKT57	C	WPN	RUSSIAN	57MM, RKT, AIR TO GRD
_ILAW	C	WPN	US	66MM, AT RKT, IMPROVED LAW
_LAW	C	WPN	US	66MM, AT RKT, M72A1, LAW
_AK47	C	WPN	RUSSIAN	7.62MM, RIFLE, AK47

_AKM	C	WPN	RUSSIAN	7.62MM, RIFLE, ASSULT
I7.62R	O	WPN	IRANIAN	7.62MM, RIFLE, G-3 (AK47 DATA)
NSNIP	O	WPN	NATO	7.62MM, RIFLE, SNIPER
_SNIPE	C	WPN	RUSSIAN	7.62MM, RIFLE, SVD, SNIPER
_ATG73	C	WPN	RUSSIAN	73MM, AT GUN, SPG-9
_CA73V	C	WPN	RUSSIAN	73MM, VEH-MTD
YRR75	O	WPN	CHINESE	75MM, RECOILESS RIFLE
_SPN76	C	WPN	IRANIAN	76MM, AT GUN, SCORPION
NPIR76	C	WPN	NATO	76MM, FSV, PIRANHA, COUGAR
NG76MM	C	WPN	NATO	76MM, FWD SPT, FV101, SCORPION (UK BUILT)
XG76	C	WPN	NKOREAN	76MM, LIGHT GUN, TOWED
_SCP76	C	WPN	US	76MM, SCORPION MAIN GUN
YRR82	O	WPN	CHINESE	82MM, RECOILESS RIFLE
_ATG82	C	WPN	RUSSIAN	82MM, RECOILESS RIFLE, B-10
NGUS84	O	WPN	NATO	84MM, RECOILESS RIFLE, GUSTAV(GE)
_AT85	C	WPN	RUSSIAN	85MM, AT GUN
NPAN90	C	WPN	NATO	90MM, ARV, PANHARD, AML-245
_90RR	C	WPN	SKOREAN	90MM, RECOILESS RIFLE
_RR90	O	WPN	US	90MM, RECOILESS RIFLE
NJPKM6	O	WPN	NATO	90MM, TANK DESTROYER, JPK/M-6
HALO-3	C	WPN	FRENCH	ALLOUTTE-3 SS-11B
UKEM	C	WPN	US	AT GUIDED MISSILE, KINETIC ENERGY
ULOSAV	C	WPN	US	AT LINE-OF-SIGHT WPN
_AWSMI	C	WPN	US	ATGM, AAWS-M
_AWSSM	C	WPN	US	ATGM, AAWS-M, JAVELIN
_AT2H	C	WPN	RUSSIAN	ATGM, AT-2, SWATTER, HELO-MTD
_AT3	C	WPN	RUSSIAN	ATGM, AT-3, SAGGER
_AT3H	C	WPN	RUSSIAN	ATGM, AT-3, SAGGERMAN, HELO-MTD
RAT4G	C	WPN	RUSSIAN	ATGM, AT-4, SPIGOT, MAN-PACK
RAT4V	C	WPN	RUSSIAN	ATGM, AT-4, VEH-MTD
_AT5H	C	WPN	RUSSIAN	ATGM, AT-5, SPANDREL, HELO-MTD
_AT5V	C	WPN	RUSSIAN	ATGM, AT-5, SPANDREL, VEH-MTD
_AT6H	C	WPN	RUSSIAN	ATGM, AT-6, SPIRAL, HELO-MTD
_AT8V	C	WPN	RUSSIAN	ATGM, AT-8
_DRAG	C	WPN	US	ATGM, DRAGON, M47
_ATP6H	C	WPN	RUSSIAN	ATGM, HELO-MTD (AT-P-6)
NHOTH	C	WPN	NATO	ATGM, HOT, HELO-MTD
NHOTV	C	WPN	NATO	ATGM, HOT, VEH-MTD, VPX/VAB/JPZ
_AAWWS	C	WPN	US	ATGM, LONG BOW, HELO-MTD, ALL WEATHER
NMILAN	C	WPN	NATO	ATGM, MILAN, IFV/AMX10/MARDER
_ATP9V	C	WPN	RUSSIAN	ATGM, VEH-MTD (AT-P-9)
_VIPER	C	WPN	US	ATGM, VIPER
_B250	C	WPN	RUSSIAN	BOMB, 250KG, (SU24,25,24G)
_B500	C	WPN	RUSSIAN	BOMB, 500KG, (SU24,24G)
_MK82H	C	WPN	US	BOMB, 500LB, HIGH DRAG
_BMM62	C	WPN	US	BOMB, HIGH PERF ACFT
_MK20	C	WPN	US	BOMB, MK20, ACFT-MTD (A-10, F4-D, F4-G)
_MK82	C	WPN	US	BOMB, MK82, ACFT-MTD (F4-G)
_TVGB	C	WPN	US	BOMB, TV GUIDED
_500CB	C	WPN	US	BOMB, W/CLUSTER BOMB UNITS, HIGH PERF ACFT
_7.6GL	C	WPN	NKOREAN	GRENADE LAUNCHER, 40MM, 7.62 RIFLE-MTD
_MK19G	C	WPN	US	GRENADE LAUNCHER, 40MM, MARK 19, GRD-MTD
_MK19V	C	WPN	US	GRENADE LAUNCHER, 40MM, MARK 19, VEH-MTD
_GL30G	C	WPN	RUSSIAN	GRENADE LAUNCHER, AUTOMATIC, AGS-17
_RPG16	C	WPN	RUSSIAN	GRENADE LAUNCHER, RPG-16
_RPG18	C	WPN	RUSSIAN	GRENADE LAUNCHER, RPG-18
_RPG7	C	WPN	RUSSIAN	GRENADE LAUNCHER, RPG-7
NM572Z	C	WPN	NATO	LANCE M572, SP
NM573A	C	WPN	NATO	LANCE M573, TOWED
_RPK	C	WPN	RUSSIAN	MG
_MG12C	C	WPN	RUSSIAN	MG, 12.7MM, CUPOLO, TANK-MTD
_MG12G	C	WPN	RUSSIAN	MG, 12.7MM, GRD-MTD
_MG12H	C	WPN	RUSSIAN	MG, 12.7MM, HELO-MTD
_MG12P	C	WPN	RUSSIAN	MG, 12.7MM, PINTEL-MTD

_MG12V	C	WPN	RUSSIAN	MG, 12.7MM, VEH-MTD
_MG14C	C	WPN	RUSSIAN	MG, 14.5MM, CUPOLO-MTD
XAA14Q	C	WPN	NKOREAN	MG, 14.5MM, QUAD, ZPU-4
_AA144	C	WPN	RUSSIAN	MG, 14.5MM, QUAD, ZPU-4
_MG14V	C	WPN	RUSSIAN	MG, 14.5MM, VEH-MTD
_RPK74	C	WPN	RUSSIAN	MG, 5.45MM, LIGHT
_MG5.G	C	WPN	US	MG, 5.56MM, GRD-MTD
_MG50G	C	WPN	US	MG, 50CAL, GRD-MTD
IAPC50	O	WPN	IRANIAN	MG, 50CAL, ON A M113 APC
_MG50P	C	WPN	US	MG, 50CAL, PINTEL-MTD
_MG50C	C	WPN	US	MG, 50CAL, TANK CUPOLO-MTD
_MG50T	C	WPN	US	MG, 50CAL, TURRET-MTD
RMG7.C	C	WPN	RUSSIAN	MG, 7.60MM, COAX-MTD
UMG7.C	C	WPN	US	MG, 7.62MM, COAX-MTD
RMG7.G	C	WPN	RUSSIAN	MG, 7.62MM, GRD-MTD
UMG7.G	C	WPN	US	MG, 7.62MM, GRD-MTD
YMG7.H	O	WPN	CHINESE	MG, 7.62MM, HELO-MTD
UMG7.P	C	WPN	US	MG, 7.62MM, M60 PINTEL-MTD
I60762	O	WPN	IRANIAN	MG, 7.62MM, M60 VEH-MTD
_MG7.V	C	WPN	US	MG, 7.62MM, M60 VEH-MTD
RMG7.P	C	WPN	RUSSIAN	MG, 7.62MM, PINTEL-MTD
_MG7.V	C	WPN	RUSSIAN	MG, 7.62MM, VEH-MTD
MINES	C	WPN	US	MINES (KEY WORD IN RALPH)
_ADATV	C	WPN	US	MISSILE, AD & AT
_AABLW	C	WPN	BRITISH	MISSILE, AD, BLOWPIPE
_NHERC	C	WPN	US	MISSILE, AD, NIKE HERC
_AAPAT	C	WPN	US	MISSILE, AD, PATRIOT
NAARAP	C	WPN	NATO	MISSILE, AD, RAPIER
_REDEY	C	WPN	US	MISSILE, AD, REDEYE, MAN-PACK
_ZXMSL	C	WPN	RUSSIAN	MISSILE, AD, SA-19, SP (2S6 FORMERLY ZSU-X)
XAS-12	C	WPN	NKOREAN	MISSILE, AD, SAM-12
XAS-7	C	WPN	NKOREAN	MISSILE, AD, SAM-7
_STNGH	C	WPN	US	MISSILE, AD, STINGER, AIR-TO-AIR, HELO-MTD
_STNGV	C	WPN	US	MISSILE, AD, STINGER, GRD-TO-AIR, PEDESTAL VEH-MTD
_STNGG	C	WPN	US	MISSILE, AD, STINGER, MAN-PACK
_HARM	C	WPN	US	MISSILE, ANTI-RADIATION
_AS-10	C	WPN	RUSSIAN	MISSILE, ASM, 275MM, 10KM RANGE
_AS-14	C	WPN	RUSSIAN	MISSILE, ASM, 400MM, 8KM RANGE
_HELFG	C	WPN	US	MISSILE, ASM, GRD HELFIRE
_HELFH	C	WPN	US	MISSILE, ASM, HELO HELFIRE, FIRED & LASED TOGETHER
_HELFS	C	WPN	US	MISSILE, ASM, HELO HELFIRE, LASED BY OH-58D
FAT245	O	WPN	FRENCH	MISSILE, AT, 245
_DRGON	C	WPN	US	MISSILE, AT, DRAGON, MAN-PACK
_DRAGV	C	WPN	US	MISSILE, AT, DRAGON, VEH-MTD
_AT3G	C	WPN	RUSSIAN	MISSILE, AT-3, SAGGER, GRD-MTD
_AT3V	C	WPN	RUSSIAN	MISSILE, AT-3, SAGGER, VEH-MTD
_AT6HZ	C	WPN	RUSSIAN	MISSILE, AT-6, AIR-TO-AIR COMBAT
_AT7G	C	WPN	RUSSIAN	MISSILE, AT-7, MAN-PACK
_FOGMV	C	WPN	US	MISSILE, FIBER OPTICS GUIDED, (FOG-M)
_M65AC	C	WPN	US	MISSILE, MAVERICK, M65, ACFT-MTD
_E65AC	C	WPN	US	MISSILE, MAVERICK, M65, ACFT-MTD (F-15 OR AV8)
_F65AC	C	WPN	US	MISSILE, MAVERICK, M65, ACFT-MTD (F-16 OR F-18)
NSTGMV	C	WPN	NATO	MISSILE, STINGRAY, CFV/ITV
AFV438	C	WPN	US	MISSILE, SWINGFIRE, AFV438
RVSWNG	C	WPN	US	MISSILE, SWINGFIRE, ON A COMBT VEH RECON (TRACK)
NMPZF	C	WPN	NATO	RKT, AT, PANZERFAUST, GRD-MTD
UAT-4	C	WPN	US	RKT, AT-4, (M136)
KHJR	O	WPN	SKOREAN	RKT, HONEST JOHN
_ICHAP	C	WPN	US	SAM, IMPROVED CHAPARRAL, (FLIR/POST) M48A1
_IHAWK	C	WPN	US	SAM, IMPROVED HAWK
NROLA2	C	WPN	NATO	SAM, ROLAND II
NROL3	C	WPN	NATO	SAM, ROLAND III
_SA11	C	WPN	RUSSIAN	SAM, SA-11
_SA12	C	WPN	RUSSIAN	SAM, SA-12

_SA13	C	WPN	RUSSIAN	SAM, SA-13
_SA14	C	WPN	RUSSIAN	SAM, SA-14
_SAX15	C	WPN	RUSSIAN	SAM, SA-15, (SA-X-15)
_SA16	C	WPN	RUSSIAN	SAM, SA-16
_SA16F	C	WPN	RUSSIAN	SAM, SA-16, FOLLOW-ON
_SA3	C	WPN	RUSSIAN	SAM, SA-3
_SA4	C	WPN	RUSSIAN	SAM, SA-4
_SA6	C	WPN	RUSSIAN	SAM, SA-6
_SA7G	C	WPN	RUSSIAN	SAM, SA-7, 70MM, GRAIL
_SA8	C	WPN	RUSSIAN	SAM, SA-8
_SA9	C	WPN	RUSSIAN	SAM, SA-9
_55100	C	WPN	RUSSIAN	TANK MAIN GUN, 100MM, T55
Y34100	O	WPN	CHINESE	TANK MAIN GUN, 100MM, TYPE 34
_59100	C	WPN	IRANIAN	TANK MAIN GUN, 100MM, TYPE 59
_X0105	C	WPN	FRENCH	TANK MAIN GUN, 105MM, AMX-30
_L1105	C	WPN	GERMAN	TANK MAIN GUN, 105MM, LEOPARD I
_LT105	O	WPN	US	TANK MAIN GUN, 105MM, LIGHT WEIGHT TANK
_M1105	C	WPN	US	TANK MAIN GUN, 105MM, M1
_M1LOW	O	WPN	US	TANK MAIN GUN, 105MM, M1 (APFSDS & HEAT ONLY)
_M1833	C	WPN	US	TANK MAIN GUN, 105MM, M1 (FROM M60A3) W/O SMART MUN
_48105	C	WPN	SKOREAN	TANK MAIN GUN, 105MM, M48A5
_A1105	C	WPN	US	TANK MAIN GUN, 105MM, M60A1
_A3105	C	WPN	US	TANK MAIN GUN, 105MM, M60A3 & AGS (XM8)
_A3833	C	WPN	US	TANK MAIN GUN, 105MM, M60A3 W/OUT SMART MUNS
KIT105	C	WPN	SKOREAN	TANK MAIN GUN, 105MM, ROK INDIG TNK
Y69105	O	WPN	CHINESE	TANK MAIN GUN, 105MM, TYPE 69
_62115	C	WPN	RUSSIAN	TANK MAIN GUN, 115MM, T62
_64115	C	WPN	RUSSIAN	TANK MAIN GUN, 115MM, T64
_X2120	C	WPN	FRENCH	TANK MAIN GUN, 120MM, AMX-32
_CH120	C	WPN	BRITISH	TANK MAIN GUN, 120MM, CHALLENGER
_CF120	C	WPN	BRITISH	TANK MAIN GUN, 120MM, CHIEFTAIN
_L2120	C	WPN	GERMAN	TANK MAIN GUN, 120MM, LEOPARD II
_M1120	C	WPN	US	TANK MAIN GUN, 120MM, M1A1
_M1STF	C	WPN	US	TANK MAIN GUN, 120MM, M1A1, FIRING STAFF
KIT120	C	WPN	SKOREAN	TANK MAIN GUN, 120MM, ROK INDIG TNK
_FT125	C	WPN	RUSSIAN	TANK MAIN GUN, 125MM, FUTURE TANK
_64125	C	WPN	RUSSIAN	TANK MAIN GUN, 125MM, T64
_72125	C	WPN	RUSSIAN	TANK MAIN GUN, 125MM, T72
_80125	C	WPN	RUSSIAN	TANK MAIN GUN, 125MM, T80
_FT135	C	WPN	RUSSIAN	TANK MAIN GUN, 135MM, W/ATGM ON RFSTII/RFTIII
_TK152	C	WPN	US	TANK MAIN GUN, 152MM, SHERIDAN
_76G76	C	WPN	RUSSIAN	TANK MAIN GUN, 76MM, PT76 LIGHT ARMD TANK
Y3485	O	WPN	CHINESE	TANK MAIN GUN, 85MM, T-34
_4790	C	WPN	SKOREAN	TANK MAIN GUN, 90MM, M47
_4890	C	WPN	SKOREAN	TANK MAIN GUN, 90MM, M48
_80AT8	C	WPN	RUSSIAN	TANK MAIN GUN, AT-8 MISSILE, T80
_SHILL	C	WPN	US	TANK MAIN GUN, SHELEIGHLIEGH MISSILE, SHERIDAN
_TOW2G	C	WPN	US	TOW, 2, GRD-MTD
_TOW2H	C	WPN	US	TOW, 2, HELO-MTD
_TOW2V	C	WPN	US	TOW, 2, VEH-MTD, IFV/CFV/HUMMV/M113
_TW2AG	C	WPN	US	TOW, 2A, GRD-MTD
_TW2AH	C	WPN	US	TOW, 2A, HELO-MTD
_TW2AV	C	WPN	US	TOW, 2A, VEH-MTD, IFV/CFV/HUMMV/ITV
_TW2BG	C	WPN	US	TOW, 2B, GRD-MTD
_TW2BH	C	WPN	US	TOW, 2B, HELO-MTD
_TW2BI	C	WPN	US	TOW, 2B, IMPROVED LETHALITY
_TW2BV	C	WPN	US	TOW, 2B, VEH-MTD, IFV/CFV/HUMMV/ITV
KTOWH	C	WPN	SKOREAN	TOW, HELO-MTD
_ITOWV	C	WPN	US	TOW, IMPROVED, VEH-MTD
_TOWV	C	WPN	US	TOW, VEH-MTD
WAM	C	WPN	US	WIDE AREA MINE SYSTEM

APPENDIX F

WEAPON EMPLOYMENT

This appendix contains two separate categories of weapons employment. The listing includes targets and all weapons that can kill them, and weapons and all targets they can kill. How to read each listing is explained below.

How to read:

(1) The following is a list of weapons and all targets that each weapon can kill.

```
UM1A1    R72125  RCA73V  RAT3V   RAT5V   R62115  RATG73  RAT2H
         RAT6H   RCA30H  RAS-14  RC30AC  RAT4G   R106RR  RMILAN
```

The left column lists a target (UM1A1). To the right is a listing of all weapons that can kill that target.

(2) The following is a list of weapons and all targets that each can kill.

```
UMG7.P   RSA14F  ROPAT3  ROPMG   RINTP   ROPMIL  RSPG-9  RRR106
         ROPR16  RM-TP   RFAIP   RFOTP
```

The left column lists a weapon (UMG7.P). To the right is a listing of all targets that each weapon can kill.

The following is a list of targets and all weapons that can kill each target.

UM1A1	R72125	RCA73V	RAT3V	RAT5V	R62115	RATG73	RAT2H
	RAT6H	RCA30H	RAS-14	RC30AC	RAT4G	R106RR	RMILAN
ULAV25	RMG14V	R72125	RCA73V	RAT3V	RAT5V	R62115	RATG73
	RAT2H	RAT6H	RCA30H	RAS-14	RC30AC	RAT4G	RAA14
UM2IFV	RRPG16	RMG14V	R72125	RMG12V	RCA73V	RAT3V	RAT5V
	R62115	RATG73	RAT2H	RMG12H	RAT6H	RCA30H	RAS-14
	RC30AC	RAT4G	R106RR	RMILAN	RAT3G	RAA14	
UM3CFV	RRPG16	RMG14V	R72125	RMG12V	RCA73V	RAT3V	RAT5V
	R62115	RATG73	RAT2H	RMG12H	RAT6H	RCA30H	RAS-14
	RC30AC	RAT4G	R106RR	RMILAN	RAT3G	RAA14	
UITV	RRPG16	RMG14V	R72125	RMG12V	RCA73V	RAT3V	RAT5V
	R62115	RATG73	RAT2H	RMG12H	RAT6H	RCA30H	RAS-14
	RC30AC	RAT4G	R106RR	RMILAN	RAT3G	RAA14	
UHC58C	RAA234						
UHC58D	RSA14	RMG14V	R72125	RCA73V	RAT3V	RAT5V	RAA234
	RAA37	R62115	RAA57	RATG73	RAT2H	RAT6H	RAT4G
	RAA14						
UHCAH1	RSA14	RMG14V	R72125	RCA73V	RAT3V	RAT5V	RAA234
	RAA37	R62115	RAA57	RATG73	RAT2H	RAT6H	RAT4G
	RAA14						
UHCH64	RSA14	RMG14V	R72125	RCA73V	RAT3V	RAT5V	RAA234
	RAA37	R62115	RAA57	RATG73	RAT2H	RAT6H	RAT4G
	RAA14						
UOPTOW	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UACA10	RSA14	RAA234	RAA37	RAA57			
UACF18	RSA14	RAA234	RAA37	RAA57			
UACAV8	RSA14	RAA234	RAA37	RAA57			

UACF15	RSA14	RAA234	RAA37	RAA57			
UACF16	RSA14	RAA234	RAA37	RAA57			
UOPSTG	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UVULCZ	RMG14V	R72125	RCA73V	RAT3V	RAT5V	R62115	RATG73
	RAT2H	RAT6H	RCA30H	RAS-14	RC30AC	RAT4G	R106RR
	RMILAN	RAT3G	RAA14				
U113A1	RRPG16	RMG14V	R72125	RCA73V	RAT3V	RAT5V	R62115
	RATG73	RAT2H	RAT6H	RCA30H	RAS-14	RC30AC	RAT4G
	R106RR	RMILAN	RAT3G	RAA14			
UACAH1	RSA14	RMG14V	R72125	RCA73V	RAT3V	RAT5V	RAA234
	RAA37	R62115	RAA57	RATG73	RAT2H	RAT6H	RAT4G
	RAA14						
UACH64	RSA14	RMG14V	R72125	RCA73V	RAT3V	RAT5V	RAA234
	RAA37	R62115	RAA57	RATG73	RAT2H	RAT6H	RAT4G
	RAA14						
UVULCA	RC30AC						
UHMVT2	RRPG16	RRPK74	RMG14V	RAKS74	R72125	RMG12V	RCA73V
	RAT3V	RAT5V	R62115	RATG73	RAT2H	RMG12H	RAT6H
	RCA30H	RAS-14	RC30AC	RAT4G	R106RR	RMILAN	RAT3G
	RAA14						
UOP60G	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UINTP	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UOPSAW	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UOP203	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UOPAT4	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14

UM-60M	RC30AC						
UM-61M	RC30AC						
UOPDRG	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UH105A	RC30AC						
UH155A	RC30AC						
UH155Z	RAT2H	RAT6H	RCA30H	RAS-14	RC30AC		
UH203Z	RAT2H	RAT6H	RCA30H	RAS-14	RC30AC		
UMLRS	RAT2H	RMG12H	RAT6H	RCA30H	RAS-14	RC30AC	
U577CP	RRPG16	RMG14V	R72125	RCA73V	RAT3V	RAT5V	R62115
	RATG73	RAT2H	RAT6H	RCA30H	RAS-14	RC30AC	RAT4G
	R106RR	RMILAN	RAT3G	RAA14			
UFDCVH	RRPG16	RMG14V	R72125	RMG12V	RCA73V	RAT3V	RAT5V
	R62115	RATG73	RAT2H	RMG12H	RAT6H	RCA30H	RAS-14
	RC30AC	RAT4G	R106RR	RMILAN	RAT3G	RAA14	
UM-TP	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UFATP	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UFAFO	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RAA14
UFISTV	RRPG16	RMG14V	R72125	RMG12V	RCA73V	RAT3V	RAT5V
	R62115	RATG73	RAT2H	RMG12H	RAT6H	RCA30H	RAS-14
	RC30AC	RAT4G	R106RR	RMILAN	RAT3G	RAA14	
UGLLDV	RRPG16	RMG14V	RAKS74	R72125	RMG12V	RCA73V	RAT3V
	RAT5V	R62115	RATG73	RAT2H	RMG12H	RAT6H	RCA30H
	RAS-14	RC30AC	RAT4G	R106RR	RMILAN	RAT3G	RAA14

UTRUCK	RRPK74	RMG14V	RAKS74	RMG12V	RMG12H	RCA30H	RC30AC
	RAA14						
UHCLHX	RSA14	RMG14V	R72125	RCA73V	RAT3V	RAT5V	RAA234
	RAA37	R62115	RAA67	RATG73	RAT2H	RAT6H	RAT4G
	RAA14						
RT72	UTW2BG	UTW2BV	UM1120	UAT-4	UAAWWS	UDRGON	UTW2BH
	UR275	UHELFH	UHELFS	UC30AC	UM65AC		
RT62	UTW2BG	UTW2BV	UM1120	UAT-4	UAAWWS	UDRGON	UTW2BH
	UR275	UHELFH	UHELFS	UC30AC	UM65AC		
RBMP5M	UMG50P	UTW2BG	UGUN25	UTW2BV	UM1120	UM203	UAT-4
	UAAWWS	UDRGON	UTW2BH	UCA20H	UR275	UHELFH	UHELFS
	UCA30H	UC30AC	UM65AC				
RBMP3M	UMG50P	UTW2BG	UGUN25	UTW2BV	UM1120	UM203	UAT-4
	UAAWWS	UDRGON	UTW2BH	UCA20H	UR275	UHELFH	UHELFS
	UCA30H	UC30AC	UM65AC				
RSA14F	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UR275	UCA30H				
RZ234Z	UTW2BG	UTW2BV	UM1120	UAT-4	UAAWWS	UTW2BH	UCA20H
	UR275	UHELFH	UHELFS	UCA30H	UC30AC		
RZPU2A	UR275	UC30AC					
RAD37A	UR275	UC30AC					
ROPAT3	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UR275	UCA30H				
RAD57A	UR275	UC30AC					
RHIPE	UTW2BG	UGUN25	UTW2BV	UM1120	USTNGH	UVULC	USTNGG
RHINDE	UTW2BG	UGUN25	UTW2BV	UM1120	USTNGH	UVULC	USTNGG

RSU24	UGUN25	USTNGH	UVULC	USTNGG			
RSU25	UGUN25	USTNGH	UVULC	USTNGG			
RMIG27	UGUN25	USTNGH	UVULC	USTNGG			
RBRDM3	UMG50P	UTW2BG	UGUN25	UTW2BV	UM1120	UM203	UAT-4
	UAAWWS	UDRGON	UTW2BH	UCA20H	UR275	UHELFH	UHELFS
	UCA30H	UC30AC	UM65AC				
RBRDM2	UMG50P	UTW2BG	UGUN25	UTW2BV	UM1120	UM203	UAT-4
	UAAWWS	UDRGON	UTW2BH	UCA20H	UR275	UHELFH	UHELFS
	UCA30H	UC30AC	UM65AC				
RBTR60	UMG50P	UTW2BG	UGUN25	UTW2BV	UM1120	UAT-4	UAAWWS
	UTW2BH	UCA20H	UR275	UHELFH	UHELFS	UCA30H	UC30AC
	UM65AC						
ROPMG	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UR275	UCA30H				
RINTP	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UR275	UCA30H				
ROPMIL	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UCA30H					
RSPG-9	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UR275	UCA30H				
RRR106	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UCA30H					
ROPR16	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UCA30H					
RM-82M	UR275	UC30AC					
RG130Z	UTW2BG	UTW2BV	UM1120	UAT-4	UAAWWS	UDRGON	UTW2BH
	UCA20H	UR275	UHELFH	UHELFS	UCA30H	UC30AC	UM65AC

RH122Z	UTW2BG	UTW2BV	UM1120	UAT-4	UAAWWS	UDRGON	UTW2BH
	UCA20H	UR275	UHELFH	UHELFS	UCA30H	UC30AC	UM65AC
RH122A	UR275	UC30AC	UM65AC				
RH152Z	UTW2BG	UTW2BV	UM1120	UAT-4	UAAWWS	UDRGON	UTW2BH
	UCA20H	UR275	UHELFH	UHELFS	UCA30H	UC30AC	UM65AC
RG152A	UR275	UC30AC	UM65AC				
RG130A	UR275	UC30AC	UM65AC				
RH155A	UR275	UC30AC	UM65AC				
RL122V	UTW2BG	UTW2BV	UM1120	UAT-4	UAAWWS	UDRGON	UTW2BH
	UCA20H	UR275	UHELFH	UHELFS	UCA30H	UC30AC	UM65AC
RL220V	UTW2BG	UTW2BV	UM1120	UAT-4	UAAWWS	UDRGON	UTW2BH
	UCA20H	UR275	UHELFH	UHELFS	UCA30H	UC30AC	UM65AC
RFDCVH	UMG50P	UTW2BG	UGUN25	UTW2BV	UM1120	UM203	UAT-4
	UAAWWS	UDRGON	UTW2BH	UCA20H	UR275	UHELFH	UHELFS
	UCA30H	UC30AC	UM65AC				
RTRUCK	UMG50P	UGUN25	UM203	UCA20H	UR275	UCA30H	UC30AC
RM-TP	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UR275	UCA30H				
RFATP	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UR275	UCA30H				
RFOTP	UMG7.P	UMG50P	UMG7.G	UM16A2	UGUN25	USAW5.	UM203
	UCA20H	UR275	UCA30H				

The following is a list of weapons and all targets it can kill.

UMG7.P	RSA14F	ROPAT3	ROPMG	RINTP	ROPMIL	RSPG-9	RRR106
	ROPR16	RM-TP	RFATP	RFOTP			
UMG50P	RBMP5M	RBMP3M	RSA14F	ROPAT3	RBRDM3	RBRDM2	RBTR60
	ROPMG	RINTP	ROPMIL	RSPG-9	RRR106	ROPR16	RFDCVH
	RTRUCK	RM-TP	RFATP	RFOTP			
UMG7.G	RSA14F	ROPAT3	ROPMG	RINTP	ROPMIL	RSPG-9	RRR106
	ROPR16	RM-TP	RFATP	RFOTP			
UTW2BG	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RHIPE	RHINDE
	RBRDM3	RBRDM2	RBTR60	RG130Z	RH122Z	RH152Z	RL122V
	RL220V	RFDCVH					
UM16A2	RSA14F	ROPAT3	ROPMG	RINTP	ROPMIL	RSPG-9	RRR106
	ROPR16	RM-TP	RFATP	RFOTP			
UGUN25	RBMP5M	RBMP3M	RSA14F	ROPAT3	RHIPE	RHINDE	RSU24
	RSU25	RMIG27	RBRDM3	RBRDM2	RBTR60	ROPMG	RINTP
	ROPMIL	RSPG-9	RRR106	ROPR16	RFDCVH	RTRUCK	RM-TP
	RFATP	RFOTP					
UTW2BV	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RHIPE	RHINDE
	RBRDM3	RBRDM2	RBTR60	RG130Z	RH122Z	RH152Z	RL122V
	RL220V	RFDCVH					
UM1120	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RHIPE	RHINDE
	RBRDM3	RBRDM2	RBTR60	RG130Z	RH122Z	RH152Z	RL122V
	RL220V	RFDCVH					
USAW5.	RSA14F	ROPAT3	ROPMG	RINTP	ROPMIL	RSPG-9	RRR106
	ROPR16	RM-TP	RFATP	RFOTP			
UM203	RBMP5M	RBMP3M	RSA14F	ROPAT3	RBRDM3	RBRDM2	ROPMG
	RINTP	ROPMIL	RSPG-9	RRR106	ROPR16	RFDCVH	RTRUCK
	RM-TP	RFATP	RFOTP				
UAT-4	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RBRDM3	RBRDM2
	RBTR60	RG130Z	RH122Z	RH152Z	RL122V	RL220V	RFDCVH

UAAWWS	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RBRDM3	RBRDM2
	RBTR60	RG130Z	RH122Z	RH152Z	RL122V	RL220V	RFDCVH
UDRGON	RT72	RT62	RBMP5M	RBMP3M	RBRDM3	RBRDM2	RG130Z
	RH122Z	RH152Z	RL122V	RL220V	RFDCVH		
UTW2BH	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RBRDM3	RBRDM2
	RBTR60	RG130Z	RH122Z	RH152Z	RL122V	RL220V	RFDCVH
UCA20H	RBMP5M	RBMP3M	RSA14F	RZ234Z	ROPAT3	RBRDM3	RBRDM2
	RBTR60	ROPMG	RINTP	ROPMIL	RSPG-9	RRR106	ROPR16
	RG130Z	RH122Z	RH152Z	RL122V	RL220V	RFDCVH	RTRUCK
	RM-TP	RFATP	RFOTP				
UR275	RT72	RT62	RBMP5M	RBMP3M	RSA14F	RZ234Z	RZPU2A
	RAD37A	ROPAT3	RAD57A	RBRDM3	RBRDM2	RBTR60	ROPMG
	RINTP	RSPG-9	RM-82M	RG130Z	RH122Z	RH122A	RH152Z
	RG152A	RG130A	RH155A	RL122V	RL220V	RFDCVH	RTRUCK
	RM-TP	RFATP	RFOTP				
USTNGH	RHIPE	RHINDE	RSU24	RSU25	RMIG27		
UHELFH	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RBRDM3	RBRDM2
	RBTR60	RG130Z	RH122Z	RH152Z	RL122V	RL220V	RFDCVH
UHELFS	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RBRDM3	RBRDM2
	RBTR60	RG130Z	RH122Z	RH152Z	RL122V	RL220V	RFDCVH
UCA30H	RBMP5M	RBMP3M	RSA14F	RZ234Z	ROPAT3	RBRDM3	RBRDM2
	RBTR60	ROPMG	RINTP	ROPMIL	RSPG-9	RRR106	ROPR16
	RG130Z	RH122Z	RH152Z	RL122V	RL220V	RFDCVH	RTRUCK
	RM-TP	RFATP	RFOTP				
UC30AC	RT72	RT62	RBMP5M	RBMP3M	RZ234Z	RZPU2A	RAD37A
	RAD57A	RBRDM3	RBRDM2	RBTR60	RM-82M	RG130Z	RH122Z
	RH122A	RH152Z	RG152A	RG130A	RH155A	RL122V	RL220V
	RFDCVH	RTRUCK					
UM65AC	RT72	RT62	RBMP5M	RBMP3M	RBRDM3	RBRDM2	RBTR60
	RG130Z	RH122Z	RH122A	RH152Z	RG152A	RG130A	RH155A
	RL122V	RL220V	RFDCVH				
UVULC	RHIPE	RHINDE	RSU24	RSU25	RMIG27		

USTNGG	RHIPE	RHINDE	RSU24	RSU25	RMIG27		
RSA14	UHC58D	UHCAH1	UHCH64	UACA10	UACF18	UACAV8	UACF15
	UACF16	UACAH1	UACH64	UHCLHX			
RRPG18	UM2IFV	UM3CFV	UITV	U113A1	UHMVT2	U577CP	UFDCVH
	UFISTV	UGLLDV					
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	UOPAT4	UOPDRG	UM-TP	UFATP	UFAFO	UTRUCK	
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	UHCLHX						
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RMILAN	UM1A1	UM2IFV	UM3CFV	UITV	UVULCZ	U113A1	UHMVT2
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RAA14	ULAV25	UM2IFV	UM3CFV	UITV	UHC68D	UHCAH1	UHCH64
	UOPTOW	UOPSTG	UVULCZ	U113A1	UACAH1	UACH64	UHMVT2
	UOP60G	UINTP	UOPSAW	UOP203	UOPAT4	UOPDRG	U577CP
	UFDCVH	UM-TP	UFATP	UFAFO	UFISTV	UGLLDV	UTRUCK
	UHCLHX						

APPENDIX G

KILLER/VICTIM MATRIX

The killer/victim matrix contains information by force for Blue attack/Red prepared defense intense. This matrix shows the interaction of equipment and weapon systems against specific targets during the simulation period. An "S" in the matrix indicates that the equipment was fired upon, but never killed. A "K" in the matrix indicates that the equipment was fired upon and killed. The target equipment names go across the top of the matrix. The shooters are listed down the left side. There are two lines for each shooter (1 - equipment; 2 - equipment and weapon). The first line shows if there is an interaction between the target equipment (as a shooter) and the shooter equipment (as a target). The second line shows if there is an interaction between the shooter equipment and weapon (second line) and a target equipment (top of matrix).

If there is a shooter listed down the side with a density of 0, then a 0 will be printed on the first line next to the equipment name to indicate this.

A-C02A02R02D02-FB-US-HADCAP-1
FB
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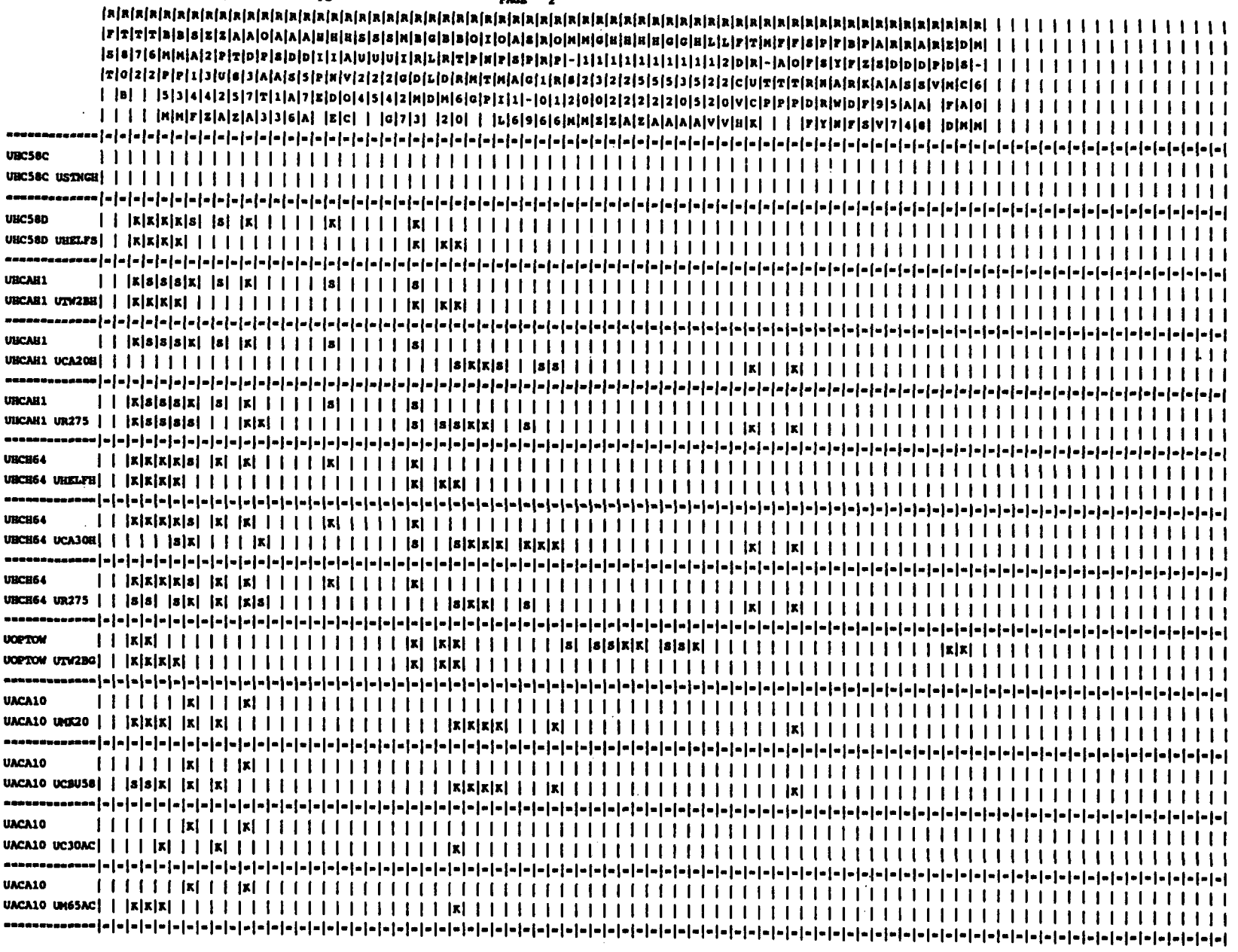

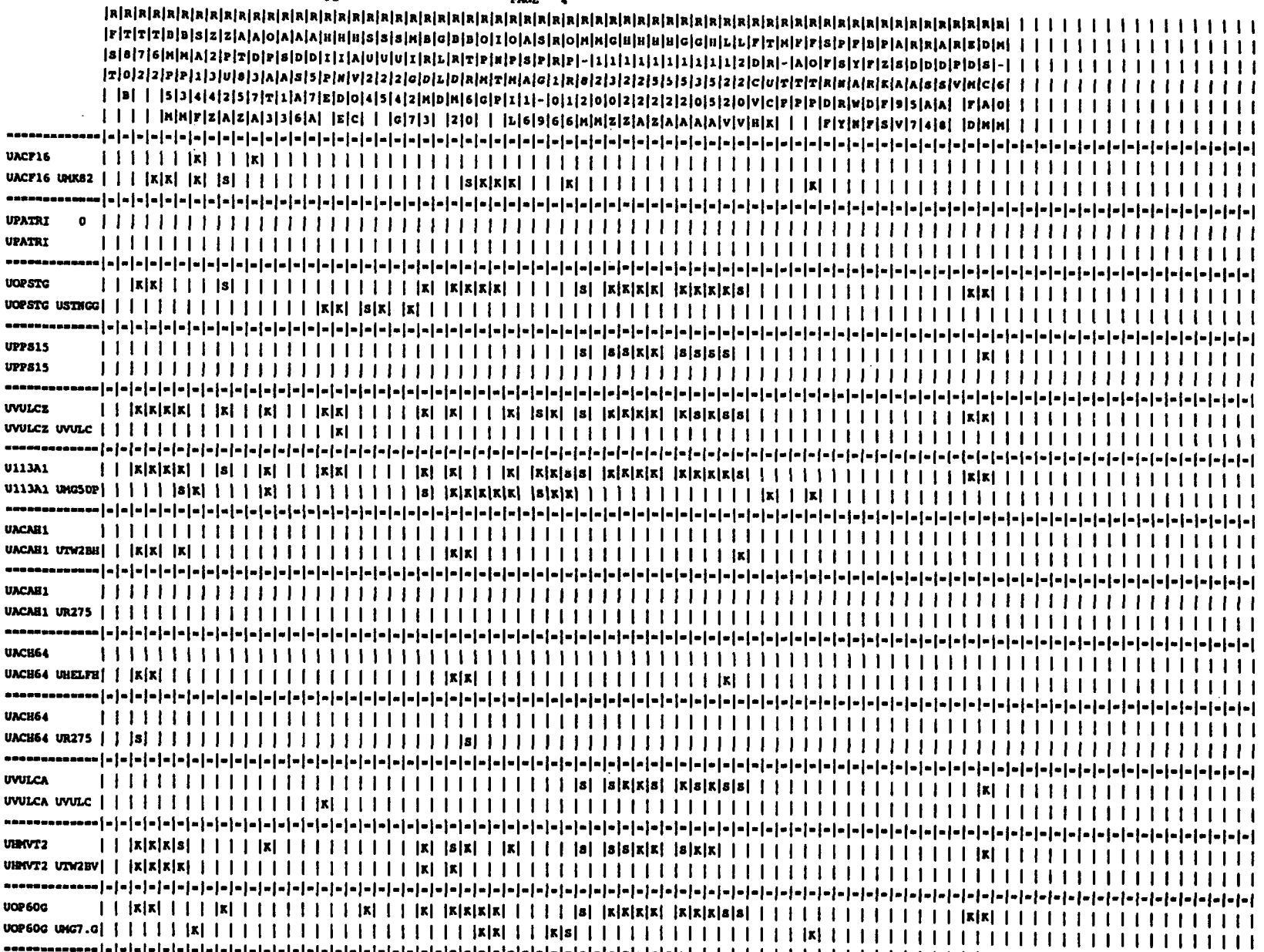

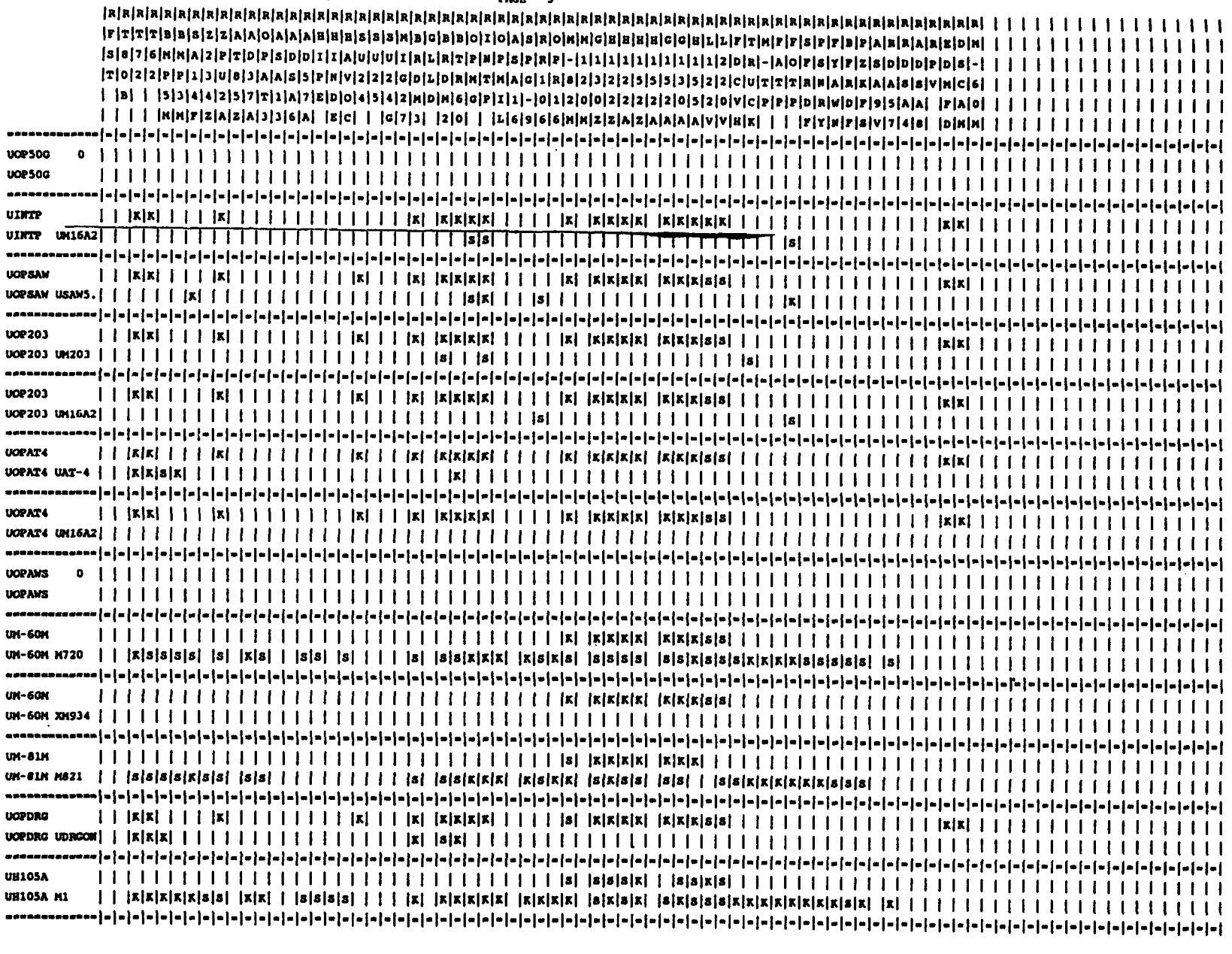
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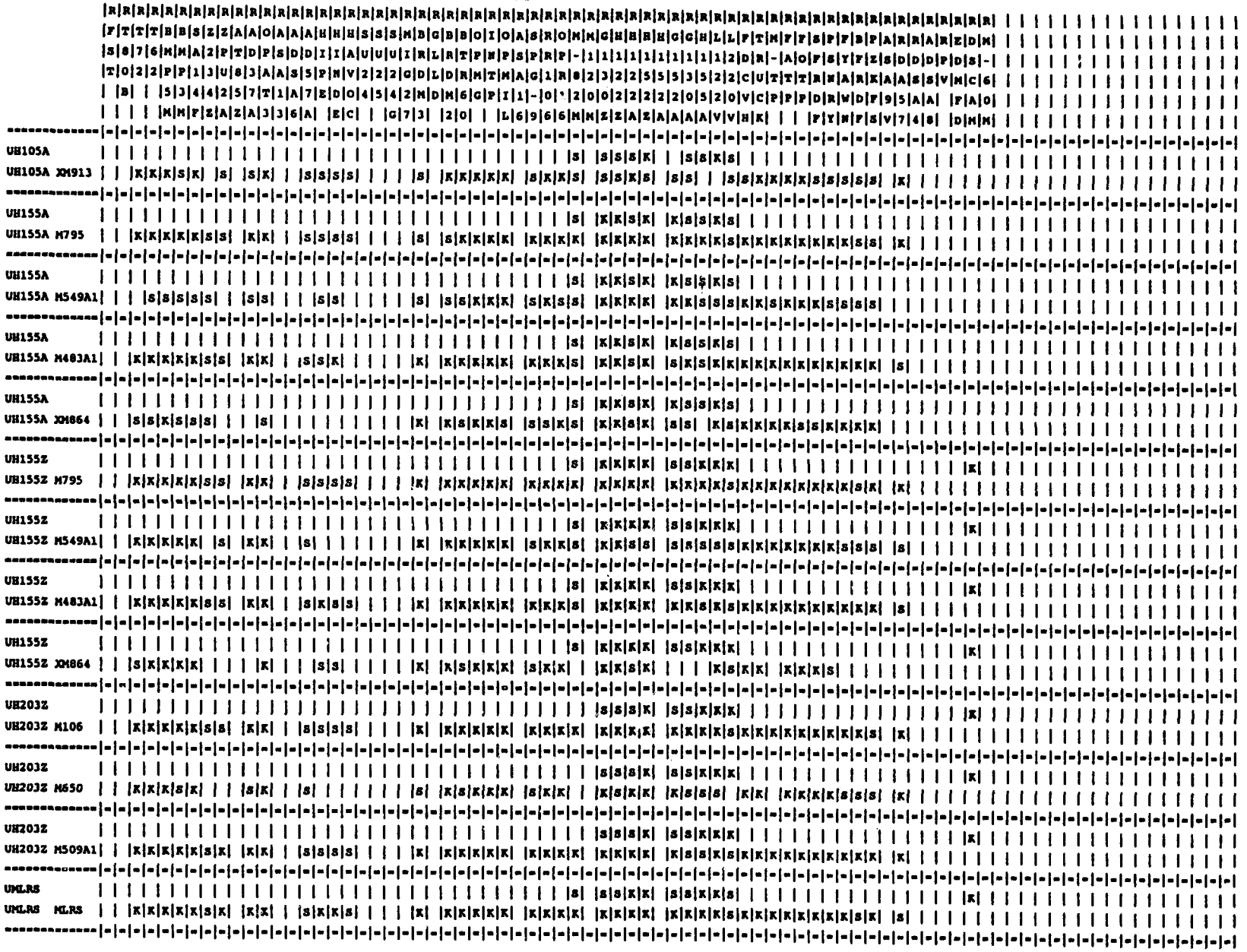
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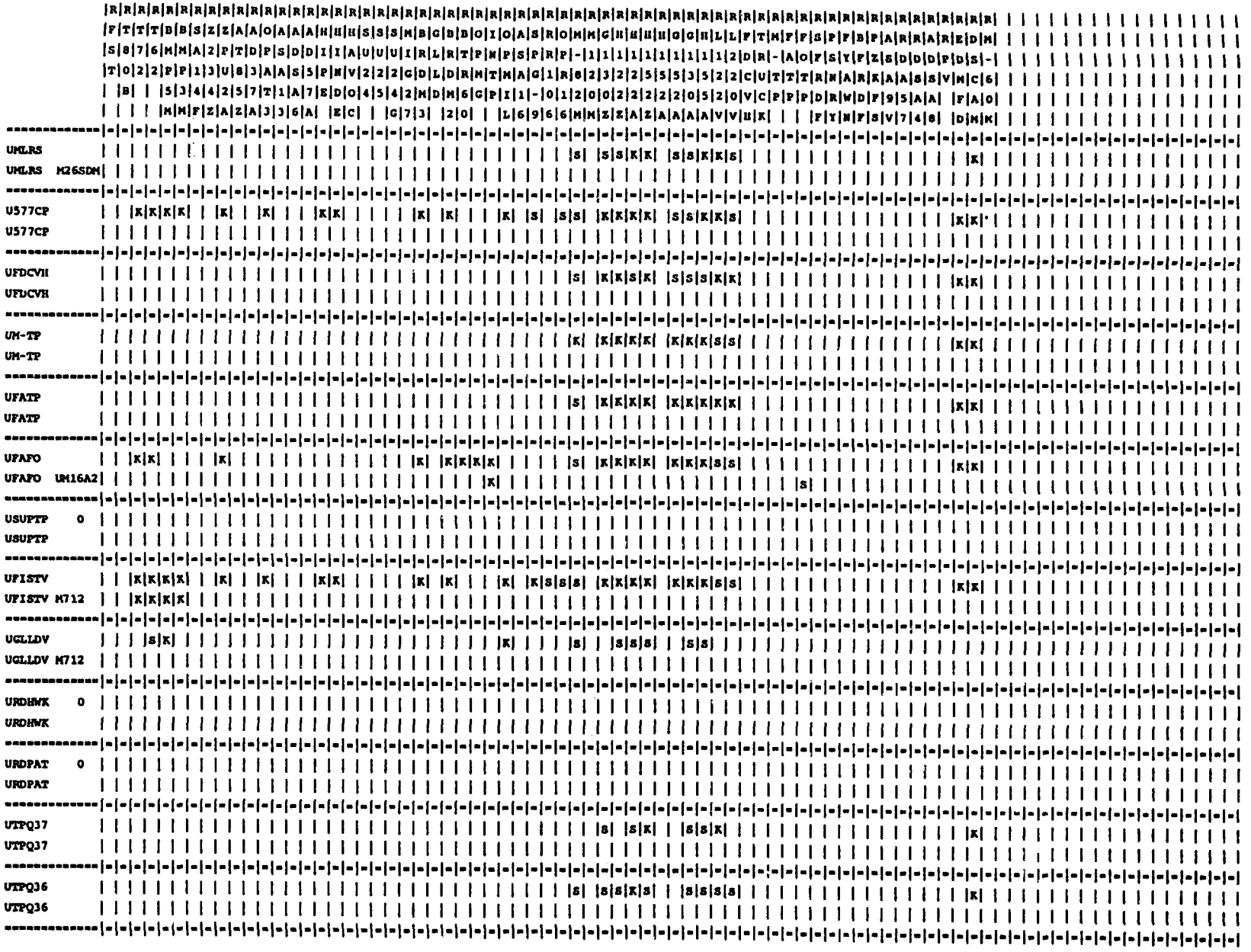

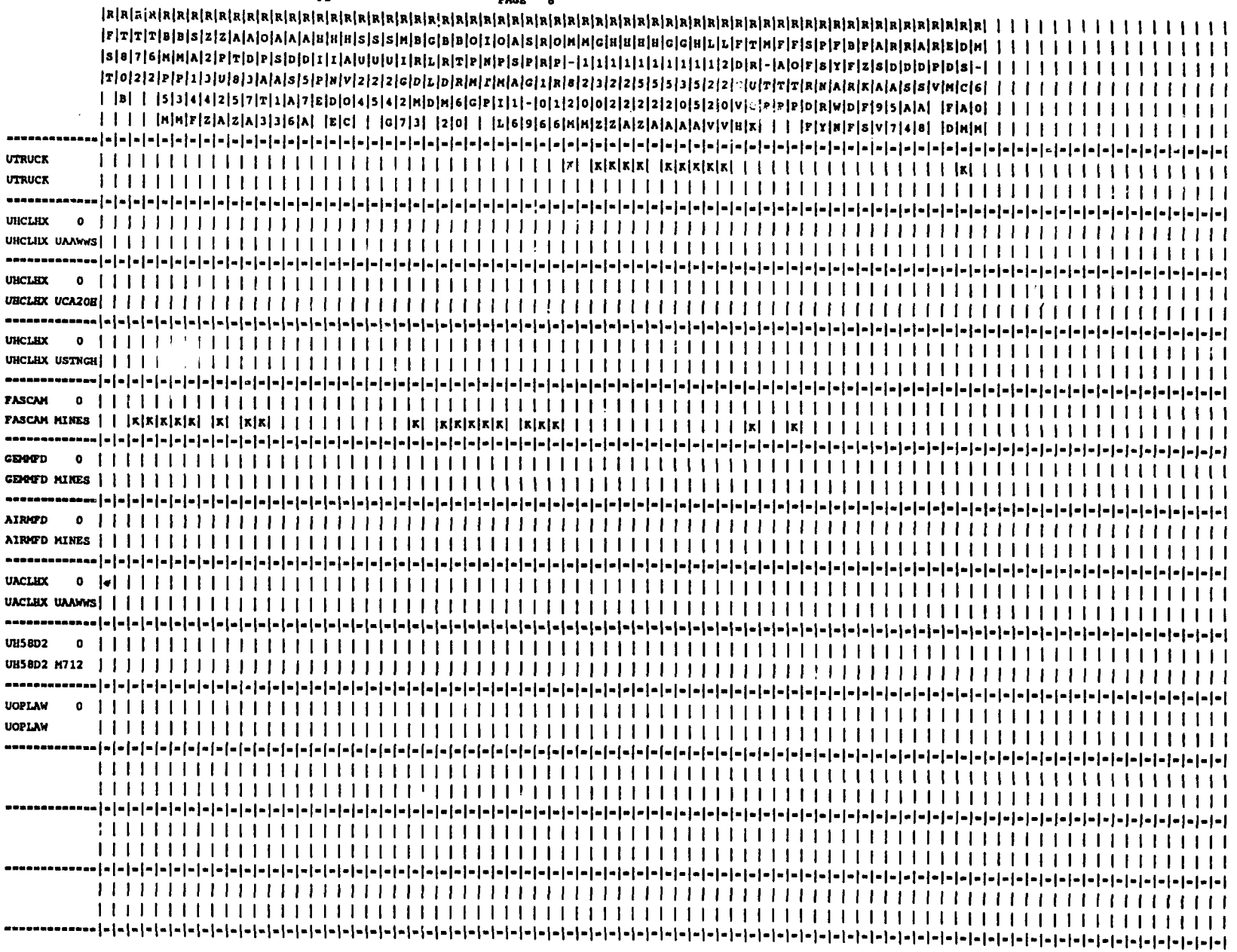
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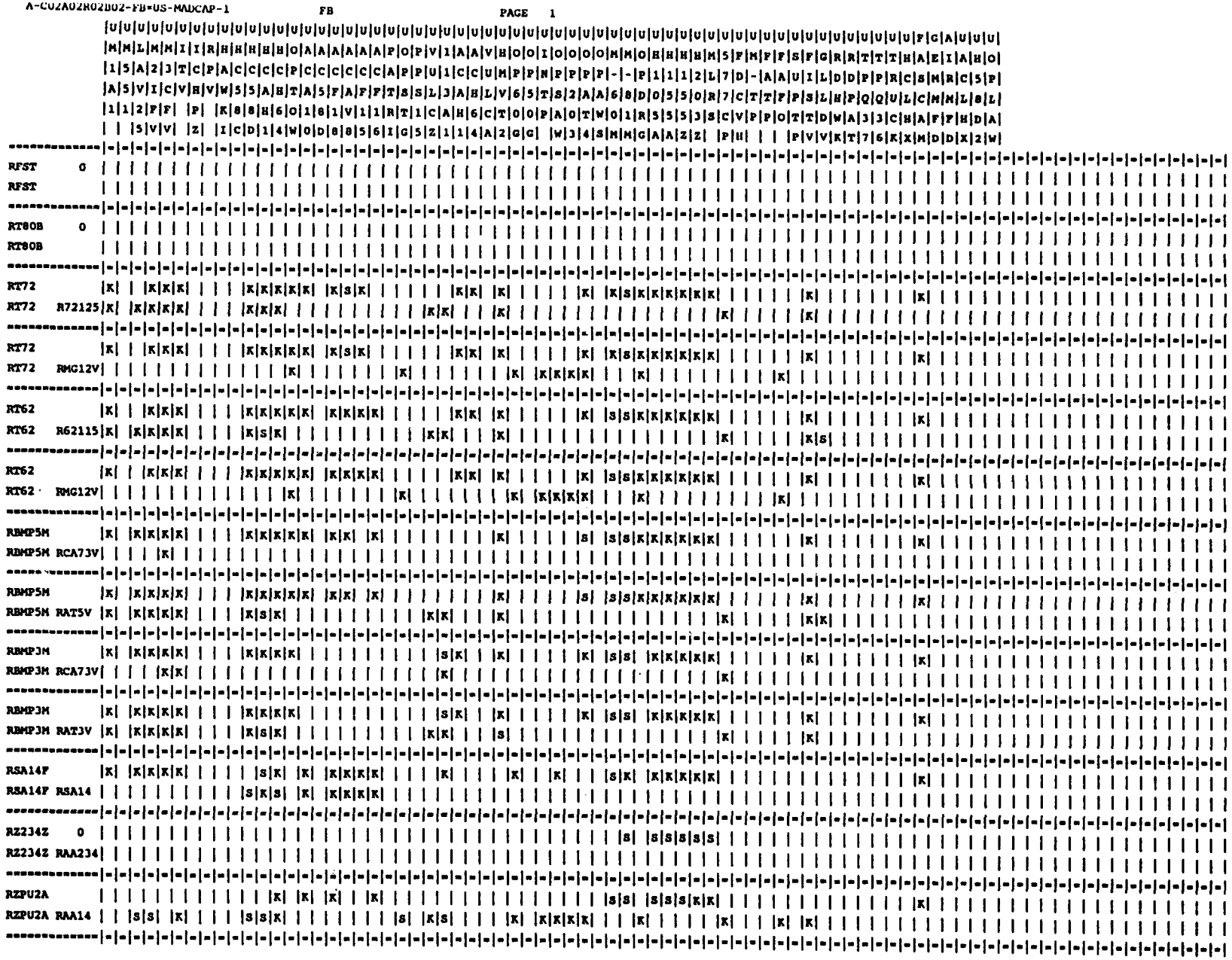
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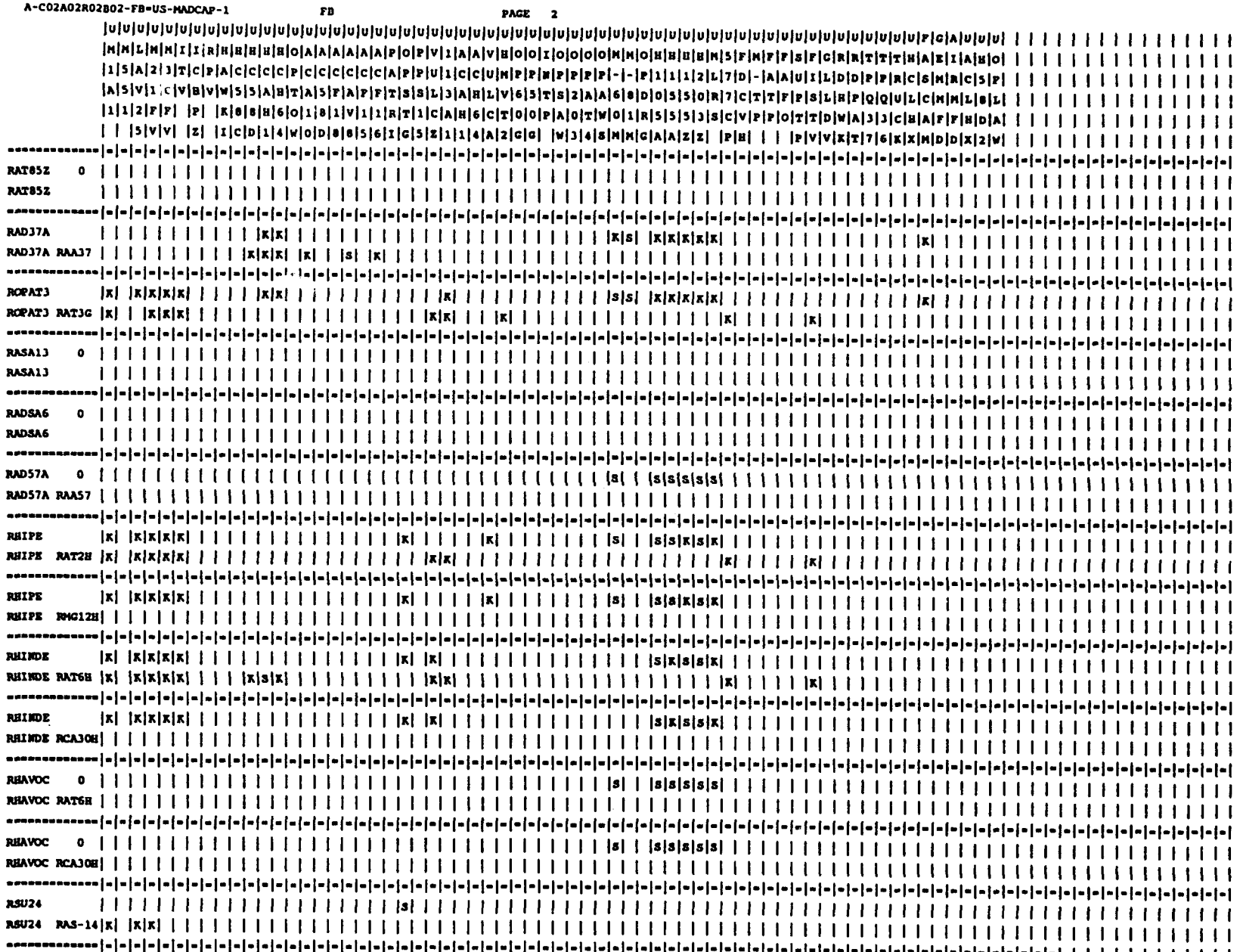

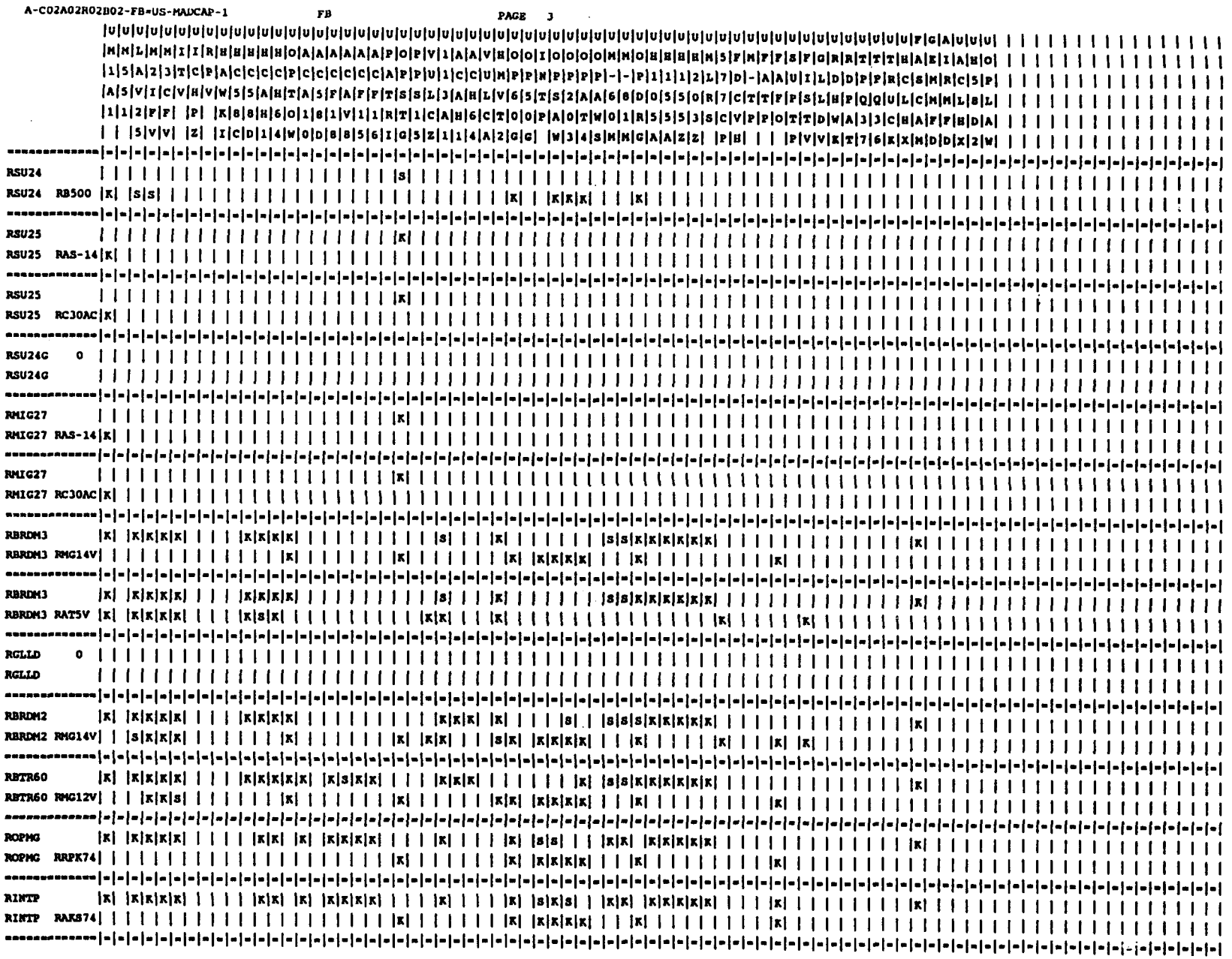
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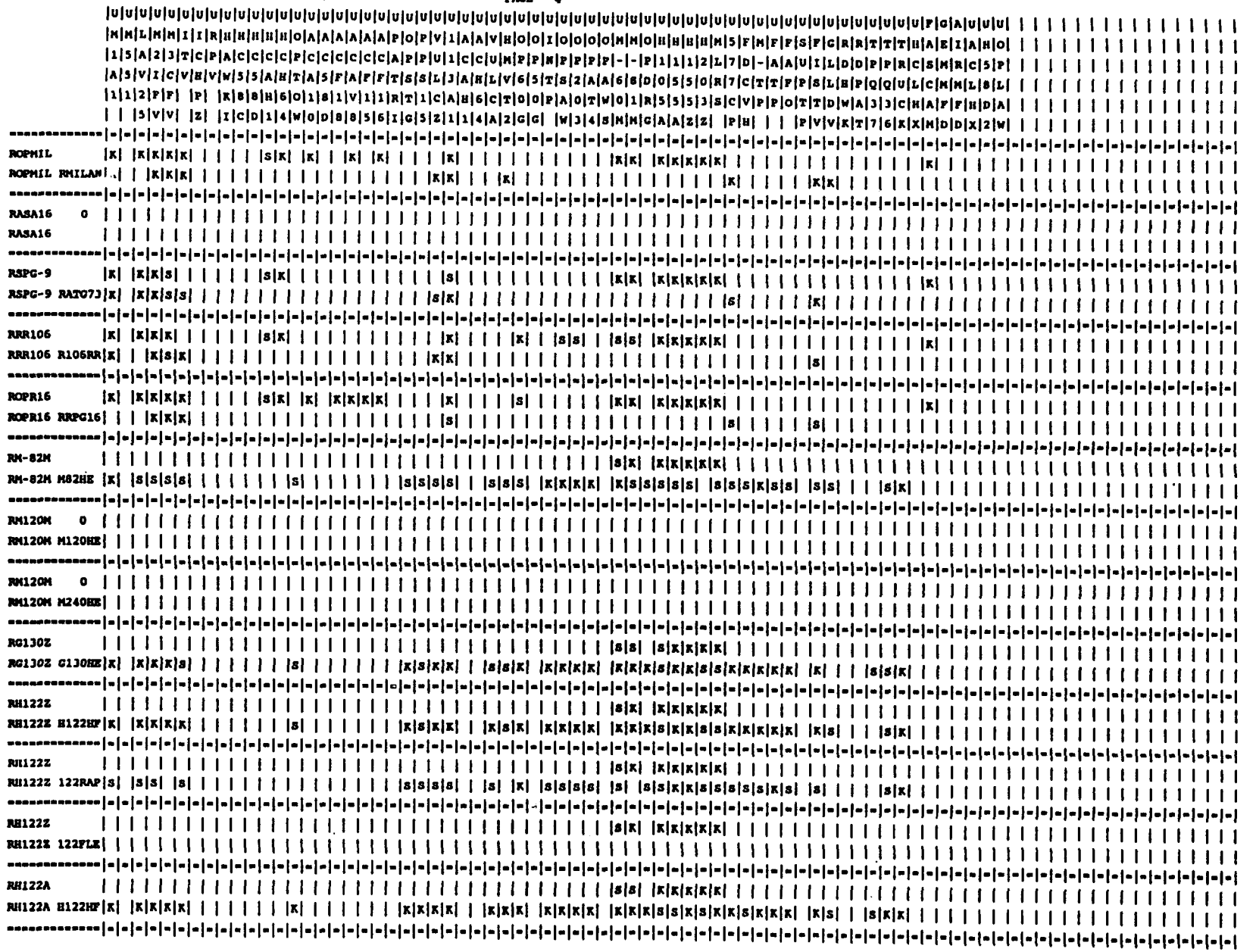

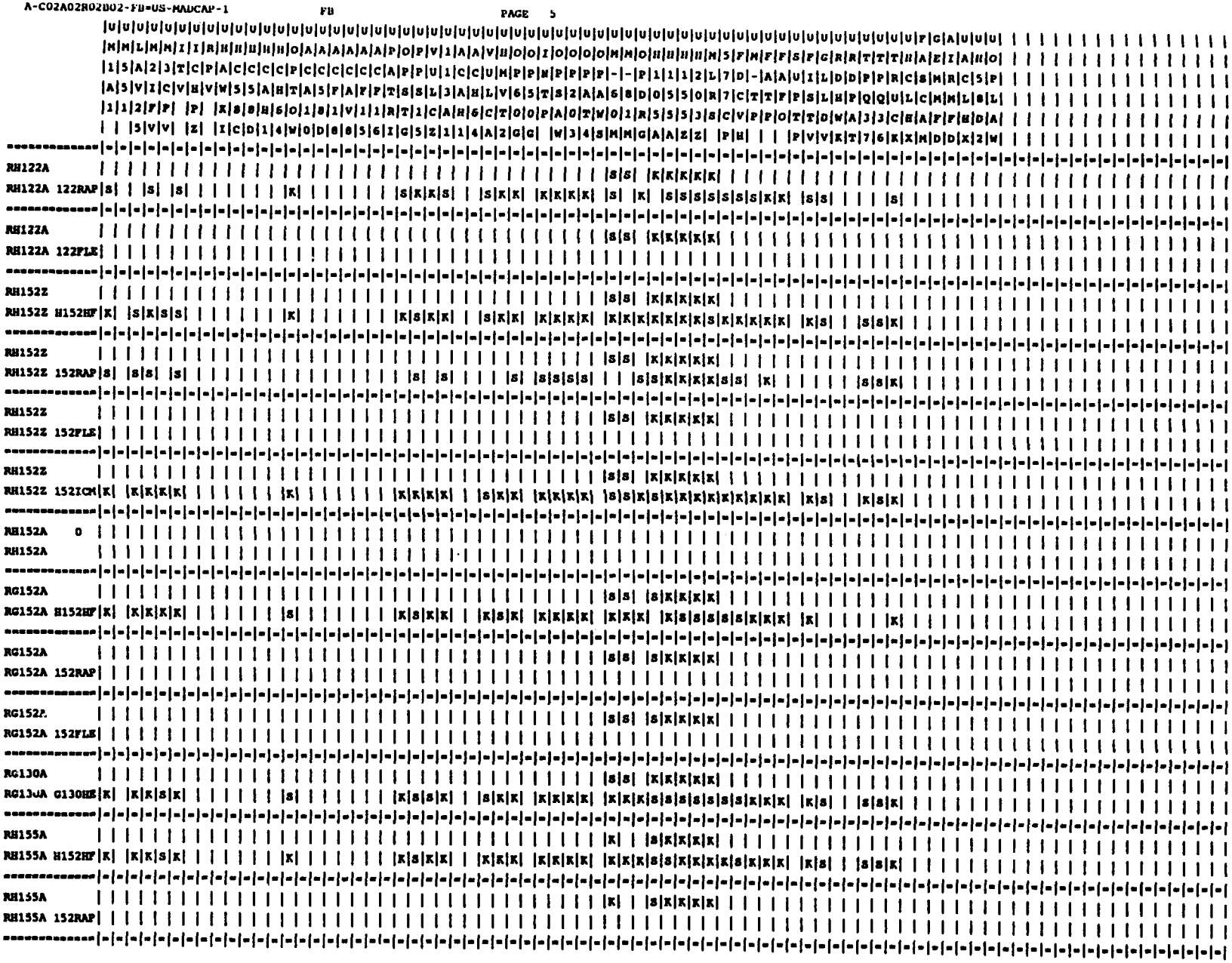

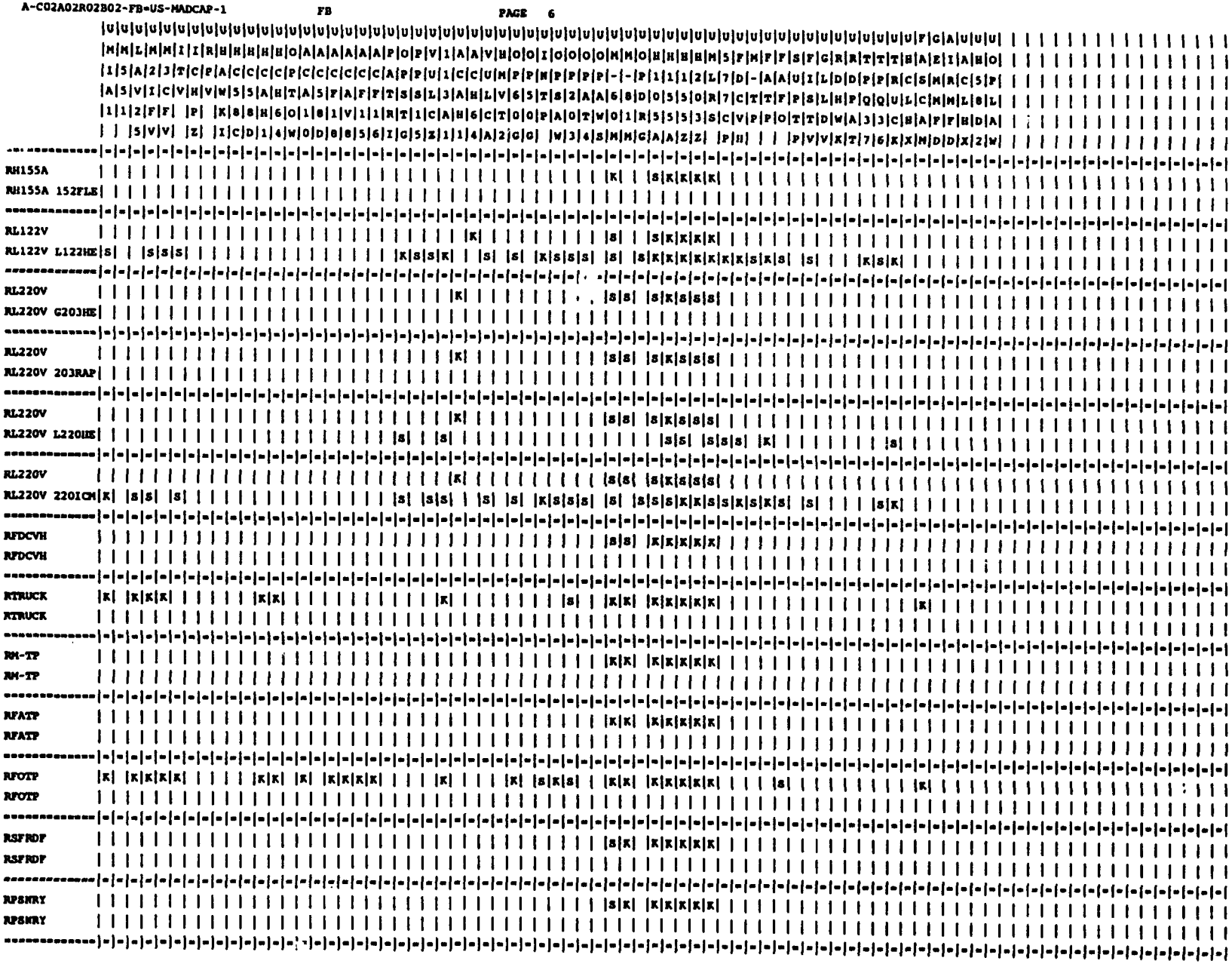

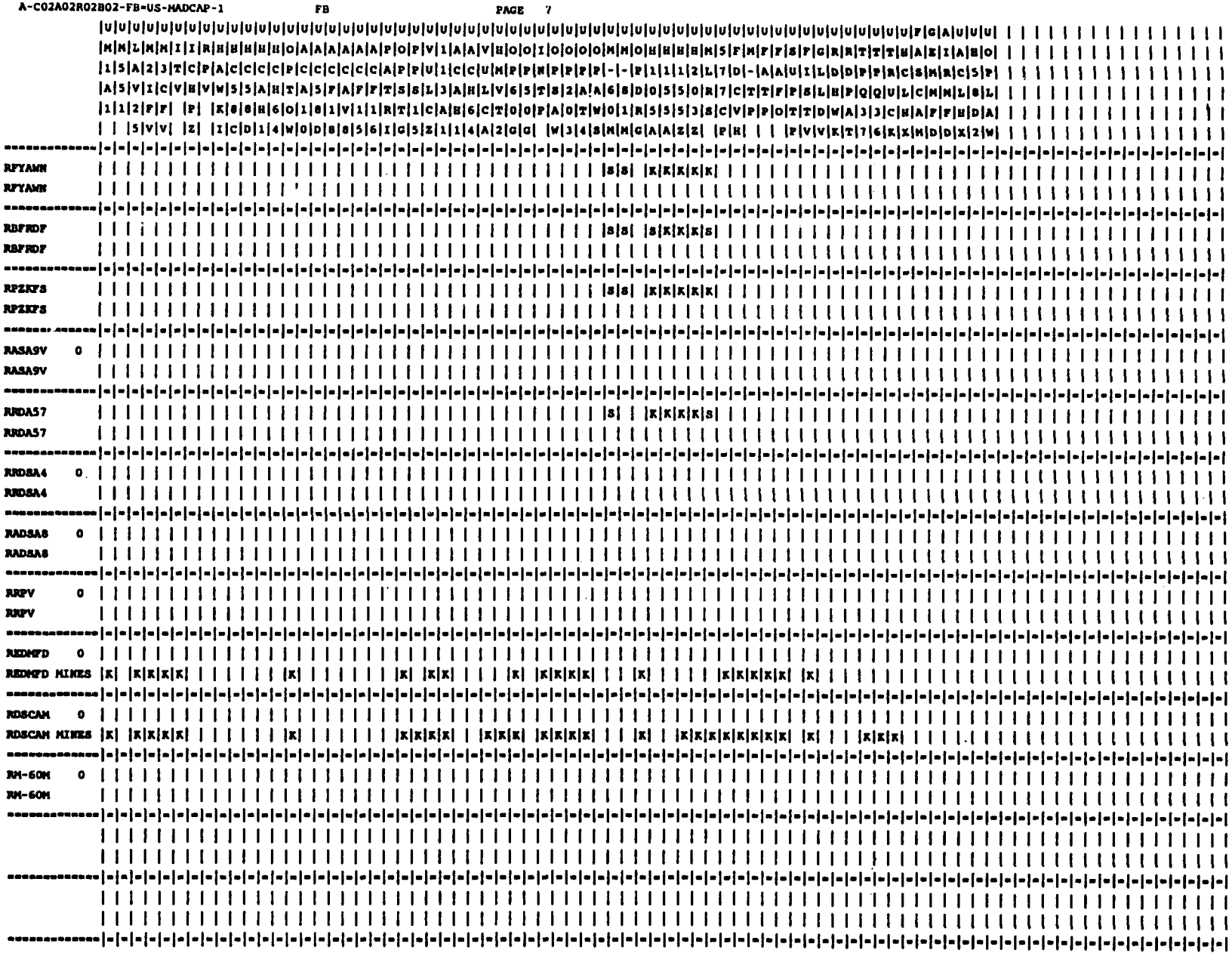
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RDSCAM 0
RDSCAM MINES
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RM-60M

APPENDIX H

BASE CASE INVENTORIES

Static base case and Red attack/Blue prepared defense intense inventories for each of the opponents are shown below for development of a stylized force. The stylized force represents the assets of the theater in a density that can easily fight the simulated combat necessary to achieve interactions between systems. The inventories shown below include some modifications to ensure a large enough sample for each type of weapon system and the tactical integrity of each unit. The static inventory represents the defense light posture. Other postures require differing force ratios, and, as a result, the inventories in those postures are larger multiples of the defense light base case. For example, the posture Red attack versus Blue prepared defense pits three Red base case units against one Blue base case unit (ratio 3:1).

Defense Light Posture (base case) - US Force Inventory

Blue equipment	Inventory	Blue equipment	Inventory
IFV	330	M577CP	117
CFV	84	FISTV	40
ITV	69	GLLVD	9
LAV	126	FDC Vehicle	68
HMMWV (TOW)	72	TPQ 37	3
OH58-D	21	TPQ 36	3
OH58-C	42	Truck	43
AH-1	36		
AH-64	56		
A-10	7		
F-15E	4		
F-16	12		
F-4D	4		
A-11	5		
AV-8	6		
F/A-18	6		
STINGER (handheld)	75		
PPS 15	5		
VULCAN (SP)	26		
M1A1	302		
M113A1	176		
M-60 MG	270		
Inf troops	861		
SAW	446		
M203 How (SP)	48		
AT4	620		
DRAGON	221		
60mm Mortar	88		
81mm Mortar	21		
105mm(T)	18		
107mm Mortar	40		
155mm How (T)	24		
155mm How (SP)	120		
MLRS	36		

Threat inventory

Red equipment	Inventory
T-62	224
T-72	180
PT76	24
BMP	288
BRDM	192
BTR	228
B10	63
ZPU 2A	4
ADA 37mm	36
ADA 57mm	0
APV MG	210
HIP	18
HIND	37
SU-24	2
SU-25	7
MIG-27	9
122 MRL	18
220 MRL	4
7.62mm MG	276
Inf troops	2985
RPG	366
AT3	76
Fwd observer	202
FA troops	2070
Mortar troops	504
120mm Mortar	0
122mm How (T)	54
122mm How (SP)	60
130mm Gun (SP)	18
130mm Gun (T)	12
152mm How (SP)	84
152mm How (T)	0
155mm (T)	18
203mm Gun	8
107mm MLR	32
122mm MLR	18
Sentry radar	17
Small Fred	17
Small Yawn	4
Big Fred	4
Trucks	923
Sound detection	2
FDC vehicle	114

APPENDIX I

FORMULA AND SAMPLE DATA

I-1. FORMULAS. Listed below are the formulas used to conduct the analysis of the study. Data output is based on a 48-hour simulation.

a. System Exchange Ratio. The system exchange ratio helps to measure the effectiveness of each of the individual weapon systems used in the simulation. The system exchange ratio demonstrates how each weapon system compared to other systems that it killed or that killed it. SER is calculated both with and without kills of the Blue system by Red air systems when those systems are included in the denominator.

$$SER = \frac{\textit{Kills of all Red major ground systems by a single Blue sytem type}}{\textit{Kills of that single Blue system type by all Red systems}}$$

b. Loss Exchange Ratio. The LER provides a measure of how the total force structure of each side did when compared to its opponent. The LER is calculated both with and without kills of major ground systems by air systems of the opposing side.

$$LER = \frac{\textit{Kills of all Red major ground systems by all Blue system types}}{\textit{Kills of all Blue major ground systems by all Red system types}}$$

c. Fractional Exchange Ratio. The FER measures the relationship between the initial force ratio and the loss exchange ratio. The FER is calculated both with and without kills of major ground systems by enemy air systems.

$$FER = \frac{LER}{\textit{Initial major ground force ratio}}$$

where the initial major ground force ratio is equal to:

$$\frac{\textit{Density of Red major ground systems}}{\textit{Density of Blue major ground systems}}$$

d. Firing Rate. The firing rate depicts weapon firing rate over a 12-hour period. This information will be used as input values for CENTCOM's theater model, TACWAR.

I-2. SAMPLE DATA. Table I-1 shows sample SER data derived from a Southwest Asia scenario. This posture is the Blue attack - Red prepared defense intense with the US forces attacking a threat force in a prepared defense posture at a force ratio of about 3:1.

Table I-1. Sample Data Blue Attack, Red Prepared Defense Intense

Blue Shooters versus Red Targets

Shooter	Density	Total losses	Weapon type	Rounds at Red	Kills of Red	SER	Firing rate system/12 hours
TACAIR	35	3.7	M65AC	89.7	62.7	17.3	1.8
			CBU58	2.8	1.4		.1
Tank	604	241.5	M1120	1,031.3	132.7	.6	1.1
Antitank	1,218	461.6	GUN25	1,686.7	311.8	.7	6.2
Attack hel	264	19.9	HELFH	681.8	266.4	13.4	.9
MLRS	72	3.5	MLRS	301.9	41.7	11.9	4.2
Artillery	420	26.3	M1	2,263.5	8.6	10.6	80.10
			M106	10,488.6	263.8		34.06
			M898	30.8	5.3		.36

Red Shooters versus Blue Targets

Shooter	Density	Total losses	Weapon type	Rounds at Blue	Kills of Blue	SER	Firing rate system/12 hours
TACAIR	18	1.8	AS-14	44.1	4.1	2.3	.81
T-72	180	161.3	72125	1,667.3	153.9	.9	2.9
T-62	224	154.7	62115	1,617.3	142.3	.9	2.5
Antitank	708	612.1	MG12V	355.2	12.7	.3	1.0
			AT-3V	641.8	141.8		.6
Attack hel	55	33.5	AT2H	466.3	76.8	2.3	2.6
MLRS	22	22	L122HE	360.6	1.4	.1	11.01
Artillery	258	153.3	G130HE	2,734.8	31.9	.5	14.98
			MINES	279.4	24.4		2.25
			H122HF	2,284	17		17.66

APPENDIX J

SPONSOR'S COMMENTS

STUDY CRITIQUE

(This document may be modified to add more space for responses to questions.)

1. Are there any editorial comments? YES If so, please list on a separate page and attach to the critique sheet.
(TRANSMITTED BY TELEPHONE TO CPT POWELL)

2. Identify any key issues planned for analysis that are not adequately addressed in the report. Indicate the scope of the additional analysis needed. _____
(1) COMBAT SAMPLES OF LESSER "FIRE-FIGHT INTENSITY"
(2) AN ANALYSIS OF FORCE RATIO VERSUS ENGAGED FORCE RATIO.

3. How can the methodology used to conduct the study be improved?
(1) INFORM CENTCOM OF PROPOSED CHANGES TO THE COMBAT SAMPLE PROCESS EARLY ENOUGH TO ALLOW FOR BETTER CONFIGURATION CONTROL AND PARTICIPATION IN THE DECISION MAKING PROCESS.

4. What additional information should be included in the study report to more clearly demonstrate the bases for the study findings? _____
NONE AT THIS TIME. ALTHOUGH CENTCOM RESERVES THE OPTION TO REQUEST MODIFIED OR DIFFERENT MODE's FOR FUTURE DOCUMENTATION.

5. How can the study findings be better presented to support the needs of both action officers and decisionmakers? _____
N/A

6. How can the written material in the report be improved in terms of clarity of presentation, completeness, and style? _____
N/A AS REVISED.

STUDY CRITIQUE (continued)

7. How can figures and tables in the report be made more clear and helpful?

N/A

8. In what way does the report satisfy the expectations that were present when the work was directed?

THIS WORK PROVIDES AN AUDIT TRAIL FOR ATTRITION DATA USED WITHIN TACWAR.

In what ways does the report fail to satisfy the expectations?

N/A

9. How will the findings in this report be helpful to the organization which directed that the work be done?

SEE (8)

If they will not be helpful, please explain why not.

N/A

10. Judged overall, how do you rate the study? (circle one)

Poor Fair Average Good (Excellent)

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GLOSSARY

ABBREVIATIONS, ACRONYMS, AND SHORT TERMS

AA	antiaircraft
AAWS-M	advanced antitank weapon system-medium
AD	air defense
AI	air interdiction
AMSAA	US Army Materiel Systems Analysis Activity
APP	antipotential potential
APC	armored personnel carrier
AT	antitank
ATCAL	Attrition Calibration
CAA	US Army Concepts Analysis Agency
CAG	Combat Analysis Group
CENTCOM	Central Command
CFV	cavalry fighting vehicle
CINC	commander in chief
COSAGE	Combat Sample Generator (model)
CTI	COSAGE-TACWAR Interface
DCSOPS	Deputy Chief of Staff for Operations and Plans
EEA	essential element(s) of analysis
EUCOM	European Command
FEBA	forward edge of the battle area
FER	force exchange ratio
FM	field manual
gnd	ground
hel	helicopter
HIMAD	high-to-medium altitude air defense

IFV	infantry fighting vehicle
ITV	Improved TOW vehicle
JCS	Joint Chiefs of Staff
km	kilometer(s)
LAV	light attack vehicle
LER	loss exchange ratio
METT	mission, enemy, terrain, troops, and time available
MG	machinegun
MLRS	multiple launch rocket system
mm	millimeter
MOE	measure(s) of effectiveness
MRC-E	Major Regional Contingency - East
MRC-W	Major Regional Contingency - West
MRL	multiple rocket launcher
NATO	North Atlantic Treaty Organization
OPLAN	operation plan
PK	operational probability of kill
rkt	rocket
SER	system exchange ratio
SHORAD	short-range air defense
SP	self-propelled
SSPK	single shot probability of kill
SWA	Southwest Asia
TACAIR	tactical air
TACWAR	Tactical Warfare Model

TOW	tube-launched, optically tracked, wire-guided (missile)
TRADOC	US Army Training and Doctrine Command
UASF	US Air Force